NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

VALIDITY OF EMPIRICAL STUDIES OF
INFORMATION SYSTEM EFFECTIVENESS

by

M. Agus Mustofa

June 1989

Thesis Advisor: William J. Haga

Approved for public release; distribution is unlimited

REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188

1a REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

1b RESTRICTIVE MARKINGS

2a SECURITY CLASSIFICATION AUTHORITY

2b DECLASSIFICATION / DOWNGRADING SCHEDULE

3 DISTRIBUTION / AVAILABILITY OF REPORT
Approved for public release;
distribution is unlimited

4 PERFORMING ORGANIZATION REPORT NUMBER(S)

5 MONITORING ORGANIZATION REPORT NUMBER(S)

6a NAME OF PERFORMING ORGANIZATION
Naval Postgraduate School

6b OFFICE SYMBOL (If applicable)
Code 54

7a NAME OF MONITORING ORGANIZATION
Naval Postgraduate School

6c ADDRESS (City, State, and ZIP Code)
Monterey, California 93943-5000

7b ADDRESS (City, State, and ZIP Code)
Monterey, California 93943-5000

8a NAME OF FUNDING / SPONSORING ORGANIZATION

8b OFFICE SYMBOL (If applicable)

9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

8c ADDRESS (City, State, and ZIP Code)

10 SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO	PROJECT NO	TASK NO	WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification)
VALIDITY OF EMPIRICAL STUDIES OF INFORMATION SYSTEM EFFECTIVENESS

12 PERSONAL AUTHOR(S)
Mustofa, M. Agus

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (Year, Month, Day)	15 PAGE COUNT
Master's Thesis	FROM _____ TO _____	June 1989	164

16 SUPPLEMENTARY NOTATION
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

17 COSATI CODES		
FIELD	GROUP	SUB-GROUP

18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Productivity, effectiveness, efficiency, evaluation, Information Systems, cost benefit, success, performance

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

This thesis reviewed 45 studies that purported to empirically assess the effectiveness of information systems. They were evaluated for (a) vulnerability to alternative explanations of reported findings, (b) effect of data collection methods upon their conclusions, (c) capacity to establish causal inference, (d) how they defined system success and (e) reported changes in organizations following information system implementation.

MIS research methods do not provide a basis for establishing causal inference. This, in turn, denies the possibility of constructing a formal theory to describe, explain or predict the successful implementation of information systems. This deficiency is worsened by the emergence of antagonistic schools of thought among MIS researchers as to how system effectiveness should be evaluated.

Recommendations are made for improvements in MIS research designs and data collection

20 DISTRIBUTION / AVAILABILITY OF ABSTRACT
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS

21 ABSTRACT SECURITY CLASSIFICATION
Unclassified

22a NAME OF RESPONSIBLE INDIVIDUAL
William J. Haga

22b TELEPHONE (Include Area Code)
(408) 646-2630

22c OFFICE SYMBOL
Code 54Hg

DD Form 1473, JUN 86 Previous editions are obsolete

#19 - ABSTRACT - (CONTINUED)

techniques. Suggestions are made for ways by which line managers and commanders as well as managers of MIS activities must become informed consumers of MIS academic research on system effectiveness.

Approved for public release; distribution is unlimited.

Validity of Empirical Studies
of
Information System Effectiveness

by

M. Agus Mustofa
Captain, Indonesian Air Force
B.A., Indonesian Air Force Academy, Jakarta, 1982

Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
June 1989

Dean of Information and Policy Sciences

ABSTRACT

This thesis reviewed 45 studies that purported to empirically assess the effectiveness of information systems. They were evaluated for (a) vulnerability to alternative explanations of reported findings, (b) effect of data collection methods upon their conclusions, (c) capacity to establish causal inference, (d) how they defined system success and (e) reported changes in organizations following information system implementation.

MIS research methods do not provide a basis for establishing causal inference. This, in turn, denies the possibility of constructing a formal theory to describe, explain or predict the successful implementation of information systems. This deficiency is worsened by the emergence of antagonistic schools of thought among MIS researchers as to how system effectiveness should be evaluated.

Recommendations are made for improvements in MIS research designs and data collection techniques. Suggestions are made for ways by which line managers and commanders as well as managers of MIS activities must become informed consumers of MIS academic research on system effectiveness.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURE

ACKNOWLEDGEMENTS

The author expresses his sincere gratitude and appreciation to Professor William J. Haga for the professional guidance and long, dedicated hours of support and assistance as my thesis advisor. Also, the author acknowledges the support of Professor Moshe Zviran as second reader. The author wishes special thanks to Professor Norman K. Denzin for his valuable assistance in reviewing and categorizing research articles using the Campbell and Stanley taxonomy. Other people whose support the author must acknowledge are the staff of the Dudley Knox library, the W. R. Church Computer Center and the Administrative Sciences Curricular Office staff at the Naval Postgraduate School. I also express appreciation for preliminary literature reviews done by Steven C, Barclift and Desiree D. Linson. Finally, the author expresses his appreciation to his wife Endah Mustofa and his children Rani and Ninik for their patience and support during these challenging months of study.

I. INTRODUCTION

The point of implementing computer-based information systems is to gain either increased operational efficiency or enhanced managerial effectiveness. These gains, however, are more often asserted or assumed than they are demonstrated or tested (Lotus, 1988; Fawcette, 1988; Bulkeley, 1987).

Starting in 1985, senior line managers and information system managers in the United States began to ask whether they were getting a payoff from their investment in information systems, especially since the advent of the personal computer.

A similar skepticism could well be evident in other countries (Maginnis, 1986;Bowen, 1986; Strassmann, 1985; Wessel, 1988; LaPlante, 1988).

A. GROWING DOUBT ABOUT THE PAYOFF FROM INFORMATION SYSTEMS

Steve Crummey (1988), of Lotus Development Corporation, assessed the current information system productivity dilemma, at least as it applied to the proliferation of desk top microcomputers: "In 1976, at the dawn of the personal computer age, corporations invested $100 million in PC (personal computer) technology. Ten years later in 1986, they spent $46 billion on PCs--and nobody really knows what those dollars are buying."

1. Questions That Arise

Seeds of doubt about the assumption that the automation of management information systems (MIS) leads to increased productivity provoke questions about the ways in which the success of these systems are evaluated:

a. What is meant by a payoff, success or benefit from the implementation of an information system?

b. What are the magnitudes of improvement in organizational functioning reported by formal studies of information system implementation?

c. What research tools are employed to gather data on the success or failure of information systems?

d. To what extent do the findings reported by formal studies of system effectiveness have scientific credibility?

2. Answering Those Questions

To address these questions, this thesis reviewed 45 formal studies, ostensibly dealing with the measurement of the effectiveness of information systems. They were examined for:

a. How they defined effectiveness, benefit or success from a system implementation.

b. How their research designs dealt with threats to validity.

c. The means by which they gathered data on system effectiveness.

d. Reported levels of improvement in organizational functioning following the implementation of a system.

The findings of this review are analyzed for their implications for:

- Senior line managers and commanders as well as managers of information system function.
- The intellectual foundations of the study of management information systems.

B. THE NEED TO STUDY PAYOFFS FROM INFORMATION SYSTEMS

After spending billions of dollars on automating the offices of white collar workers, organizations find that they must now scrutinize the claims by computer vendors about increased productivity. To effectively manage a resource an organization must have a means to measure its benefits as well as its costs.

An appropriate managerial question that arises is whether an organization is getting a return on its investment in a resource. This necessity is not diminished because the resource in question is a management information system. Managers of information systems are pressed by senior line management to answer, again and again, the question, "What is the value of the company's investment in information systems?" (Matlin, 1979).

According to Strassmann (1976), "Industries and governments all over the world are currently struggling to contain rising administrative and clerical overheads by automating information handling in the office."

While the clerical work force has been the fastest growing segment of the labor force in nearly every industrialized country since the 1960s, the productivity of this sector has been flat since the early 1970s (Harris, 1987). This has been the result despite the fact that 40% of capital spending (in the U.S.) has been directed at information technology.

General managers in the United States surveyed by the University of Minnesota Management information Systems Research Center (Brancheau and Wetherbe, 1987) ranked the measuring of system effectiveness as the fourth most critical problem they face in managing information systems. Sixty per cent of the Management Information Systems executives polled

in the same survey placed the measuring of effectiveness in their Top Ten list of critical problems. The assessment of system success has been in the Top Ten list of critical MIS problems since it was first formulated in 1980.

C. THE NEED TO DEVELOP A FORMAL THEORY OF SYSTEM EFFECTIVENESS

Clearly, then, the evaluation of the success of information systems is viewed by senior line managers, and by MIS managers, as being in the forefront of their concerns. While these executives represent the sectors who have the most at stake in the successful implementation and exploitation of information systems, in the social division of labor they are not the agents of measurement.

That task falls to a neutral sector of the information systems realm: the academic scholars of MIS. Management must examine not only the effectiveness of information systems but also the effectiveness of the ways by which effectiveness itself is studied. It is the job of the MIS scholar to discover and systematize what is known about system effectiveness. A theory of system implementation would express what is known, what is predicted and what is assumed about the success of information systems. Without a formal theory of system implementation, we cannot competently describe, explain or predict.

1. Functions of a Theory of System Effectiveness

A formal theory of system effectiveness would be the basis for describing, explaining and predicting system effectiveness (Denzin, 1970):

- Description--Formal theory permits the description of a phenomenon is such a way that others can repeat a

study with a high degree of agreement. Formal theory can provide the descriptive data that can answer the managerial question "What is the payoff of information systems?"

- Explanation--Formal theory consists of a set of interrelated propositions such that some can be deduced from others and, together, they make sense out of what is observed (Homans, 1964). To say that a phenomenon has been explained is to argue that its occurrence in the future can be predicted. Explanation assumes that the causality problem has been resolved: that covariance, time order and the exclusion of rival causal factors have been established.

- Prediction--Prediction is the test of explanation. If we claim to have explained why a given set of variables occurs together we must be able, by definition, to predict their future relationships.

2. What a Formal Theory of System Implementation Is Not

A formal theory of system implementation is something apart from what is usually described colloquially by the term "theory."

a. A model is not a theory. Models are sets of relationships built upon assumptions. Some of these assumptions may be based upon rigorous empirical assessment or upon an empirical base of everyday experience. But a model itself is a metaphor; it is used as an aid to description. However, a model is not a foundation for deriving testable hypotheses from interrelated propositions.

b. Conceptual frameworks are not theories.

c. A single proposition, say, if **X** then **Y** is, by itself, not a formal theory.

d. Nor do sets of propositions, by themselves, constitute theory. They must be arranged in a deductive scheme (Homans, 1964).

e. Taxonomies are not theories although they may be a starting point in the development of propositions that can lead to formal theory.

f. Criticism, journalistic observation or hunches are not theories.

D. ELEMENTS OF A FORMAL THEORY OF SYSTEM IMPLEMENTATION

1. Formal Theory as Interrelated Propositions

A formal theory consists of a set of testable propositions that are related in such a way that some are deduced from others. That is, for example, Proposition Three may be deduced from Propositions One and Two while Proposition Four can be deduced from Propositions Two and Three.

2. The Function of Propositions in Building Formal Theory

The propositions that are the first level of analysis in theory construction are themselves statements of relationships between the next level of analysis, the concept. Concepts are the bricks in the building of formal theory held together in propositional statements.

In the proposition <u>If **X** then **Y**</u> **X** and **Y** are the concepts. The use of concepts is critical in the development of a formal theory. A formal theory, like the proverbial chain, is only as strong as its weakest concept. Concepts represent pieces of reality. They have three functions:

a. Introduce new points of view into a scientific process.

b. Convert perceptions of an environment into scientific activity.

c. Make possible deductive reasoning.

3. Concepts as the Basis of Propositions

Through concepts, everyday experience can be raised to the level of shared knowledge. Nonetheless, a specific concept is a commitment to a single viewpoint, excluding all others by its formulation. A concept is also a plan of action to observe a phenomenon. Concepts suggest operational

activity and measurement. At the conceptual level, as shown in Figure 1, a propositional statement takes the form if A, then B. If user involvement is high, then a system implementation will be successful.

This statement is put into a testable form at the operational level. It is expressed in the form that a high score on an attitudinal scale indicating user involvement leads to a high score on an attitudinal scale indicating user satisfaction. A researcher proposes a null hypothesis that no relationship exists between the scales. Specifically, that, say, a Pearson correlation of the reported scores will be zero.

The alternative hypothesis will be that some relationship exists between the scales. Again, the specific practice will be to reject the null hypothesis and accept the alternative if the probability, of a reported Pearson correlation (or similar gauge of the association of two variables) having occurred by chance alone, is less than .05.

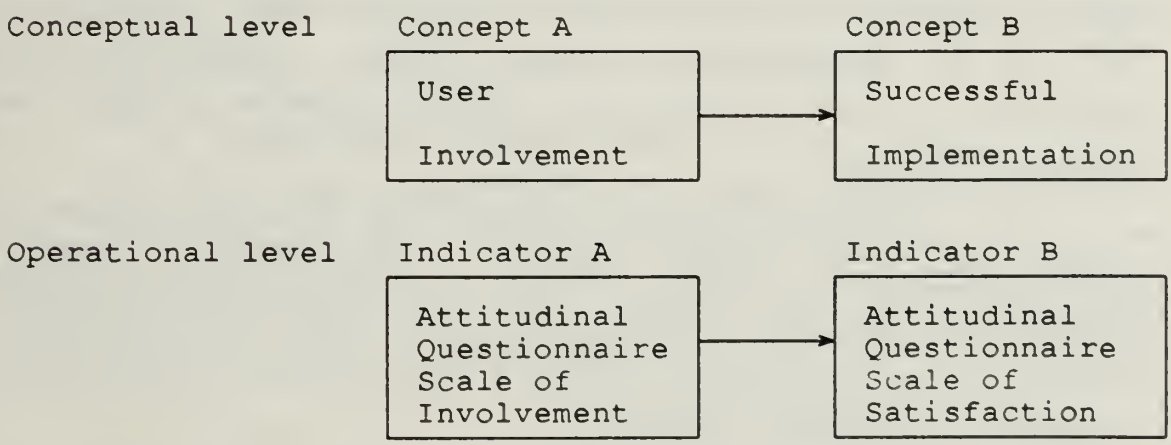

Figure 1. Operationalizing Concepts

a. Definition of Concepts

Defining a concept is a critical link in the conceptualization of theory. A definition must specify what is included in the concept (not what is excluded). They should be expressed in scientific language, not in everyday, colloquial language.

That means that the expression should have a high degree of consensus among its users as to what it refers. Moreover, a definition must not be a tautology. Rather, it must have an external reference.

b. Nominal Definitions

This is the primitive level of defining a concept. Generally, it means nothing more than substituting one word for another or employing pseudo-mathematical notation. An example would be the use of a capital letter S to be a symbol for the concept of self.

Nominal definitions have no meaning beyond that arbitrarily given to them (Bierstadt, 1959). No claim to empirical verification is possible. A nominal definition cannot be proven true or false because, by definition, it is just as it is defined (Denzin, 1970). Being true by definition, nominal definitions cannot provide a basis for causal inference.

At root, they are useless for the construction of propositions for formal theory. Nonetheless, nominal definitions are not without utility. The use of pseudo-mathematical notation at least has the virtue of economizing on space in published matter.

Further, a nominal substitution of one term for another that is burdened with emotional baggage allows a

concept to be treated in a manner that is more scientific and less ideological. Finally, nominal definitions can be a medium by which new terms and concepts are introduced into scientific usage.

c. Real Definitions

A real definition resolves a concept into its constituent parts (Denzin, 1970). For example, user involvement can be defined as the users of a system that participated in its development and implementation. This definition can be looked at in terms of users, system, participation, development and implementation. It points immediately to specific steps for observation.

The attitudinal scale used in an example earlier would need to have sets of items that measured the degree to which a respondent was (1) a user, (2) used the system being evaluated, (3) participated in development and (4) participated in implementation.

Moreover, a set of items would also be needed to establish the meaning of the term "participation" to each respondent. The test of a real definition is made in terms of the empirical observations it can generate.

d. Operational Definitions

An operational definition prescribes what to do to observe a concept. It is the vehicle by which real definitions are translated into empirical tools. It is tantamount to an empirical indicator at the operational level of a proposition.

E. CONDITIONS FOR ESTABLISHING CAUSAL INFERENCE

1. The Function of Causal Inference in Building Formal Theory

The foundation of formal theory is a set of testable propositions that, finally, can lead from explanations to predictions. That implies that concepts in a proposition must be expressed in causal order. The proposition, <u>if Concept X, then Concept Y</u> requires that Concept X be the cause of Concept Y.

2. Three Conditions for Establishing Causality

For Concept X to be established as the cause of Concept Y, three conditions must be met:

a. Covariance: both X and Y must vary.

b. Time order: X must vary first followed by variance in Y.

c. Rival hypotheses that can explain any observed variance in Y must be excluded.

a. Time Order

Establishing time order between two variables requires that the design of an empirical investigation must account for time. Evidence must be gathered at more than a single point in time. This suggests a longitudinal or time-series design. If the effect of an intervening or independent variable X upon a dependent variable Y is of interest, then the design must involve collection of data before the appearance of X (observation one: O1) and again following the intervention (observation two: O2). A pretest observation and a posttest observation around the occurrence of the intervening variable X is expressed in this notation:

O1 X O2

A difference between O1 and O2, ceteris paribus may be attributed to the intervening effect of X.

b. Rival Explanations for Observed Changes

Things, of course, are not otherwise equal. Alternative explanations arise to account for differences between O1 and O2. These rival explanations are represented by the threats to internal validity (Campbell and Stanley, 1966) and by the particular techniques by which data are collected (Denzin, 1970; Phillips, 1971).

Internal validity deals with the issue as to whether reported findings are due to the effect of an experimental variable or due to other causal factors for which no accounting was made in the design of the research. Some threats to internal validity deal with spurious conclusions based upon observations made before and after the effect of an intervening experimental variable. Others deal with erroneous conclusions based upon supposed differences between comparison groups.

The threats to internal validity are (Campbell and Stanley, 1966):

- History effects.
- Subject maturation.
- Re-test sophistication.
- Changes in instrument calibration.
- Statistical regression.
- Bias in selection of subjects.
- Differential subject drop-out effect.
- Interaction of selection bias and maturation effect.

The content and affect of each of these threats are explained in detail in Chapter III.

The techniques by which a researcher collects data can have a similar effect on his or her conclusions. A study might report an observed level of user satisfaction with the implementation of a new system, ascribing this finding to the effect of experimental variable X, say a program to involve users in the system's design. Yet, in reality, the observed difference might be caused by the very wording of the questions in a questionnaire used to measure satisfaction. The order in which the questions appear in a questionnaire or the graphic format of the questionnaire itself could also create the observed effect.

The difficulty with the ways in which researchers collect data is, according to Phillips (1971) that, "...our measurements of most variables are caused less by the 'true' values of those variables than by the effects of measuring them." If the three conditions of covariance, time order and the exclusion of rival explanations are met, then a researcher can confirm that a Concept X is the cause of a Concept Y. If the study of system effectiveness can establish causal inference by generating causal propositions, then it has the foundation for constructing a formal theory of system effectiveness.

If students of information systems can construct a formal theory of system effectiveness, then the discipline of MIS will be able to describe, explain and predict the conditions under which an implementation of an information system is likely to be a success or a failure. If an academic discipline is not engaged in the construction of formal theories that describe, explain and predict, what then is it doing. If a field of inquiry is not engaged in doing science, it risks being condemned to impotency and irrelevancy.

II. LITERATURE REVIEW

A. COST-BENEFIT ANALYSIS

Findings on whether or not Cost-Benefit Analysis should be used, the problems and weaknesses associated with using it and the methods by which it should be conducted are summarized below.

Ives, et.al (1983), states that:

> Theoretically, the determination of information system value is a matter of economics: the costs of system operation and development are subtracted from the actual benefits (in organizational effectiveness) to obtain the net value of the system to the organization.
>
> In practice: 1). intangible costs and especially benefits of the information systems are difficult to recognize and to convert to their monetary equivalent; 2). Some DSS are used for disparate, relatively unstructured, ad hoc decisions; objectively assessing the benefits of such systems may be nearly impossible; 3). Data on system success may be determinable but not recorded by the organization and, therefore, unavailable for research purposes.

Keen (March 1981), suggest that traditional cost-benefit analysis is not well-suited to Decision Support System. However, he notes that it is effective for many computer-based systems. Cost-benefit analysis is sensitive to assumptions such as discount rates and residual value.

If cost-benefit analysis is appropriate or can be applied, there are problems or weaknesses. Chervany and Dickson (1970) note that, a major source of difficulty is the failure to view Management Information System development and evaluation as a problem in decision-making. Keen (1981) identifies,

a general weakness of the cost-benefit approach as being its requirement for knowledge, accuracy and confidence about issues which for innovations are unknown, ill-defined and uncertain. The complex calculations of cost-benefit analysis are replaced in value analysis by rather simple questions about usefulness.

King and Schrems (1978), highlight three problems with using cost-benefit analysis for evaluating decisions about information system in organizations. First, the difficulties of assigning cost and benefits, second, the failure to specify the critical characteristics demanded of the system and finally, social and political realities.

There are several methods suggested in the literature for conducting cost-benefit analysis; the most common methods are discussed in the following paragraph. Chervany and Dickson (1970), conclude that:

> It is the prime responsibility of the MIS specialist to synthesize these three elements - controllable variables, constraints, and uncontrollable variables - and project payoff functions (costs and benefits) for the alternative MIS configurations under consideration.

They further note that cost-benefit analysis are the results of decisions, of not time; therefore, techniques of economic evaluation of management information systems must be decision-activity oriented.

B. USER SATISFACTION

This section summarizes comments and observations from several authors on user satisfaction. First, a discussion on productivity gains that can be addressed by Management Information System is presented. Next, effectiveness and

efficiency for users information system are discussed. Finally, some of the expected payoffs and costs are described.

Chandler (1982) states:

IS can be evaluated from two different perspectives:

- Focus on the computer system domain, where performance is measured in terms of resource utilization, cost and efficiency.
- Focus on user domain throughput, where reliability and response time are common measures.

An information system can be viewed as a symbiotic relationship between the users of the system and the system itself. Ideally, an information system should be evaluated with equal consideration given to both user constraints and to system constraints.

1. Productivity

Amerrezvani (1986) said, "the recent explosion of information technology has loosed a Pandora's box of questions about how computers and electronic communications can be used effectively in the workplace, however, current uses of PCs don't always contribute markedly to productivity".

Olson and Lucas (1982) point out that, "Office Automation is expected to increase organizational productivity through redefinition of office work rather than increase efficiency of current office functions." Additionally they state that, "Automated office systems can provide a powerful mechanism for increasing productivity and improving the quality of work life by changing the fundamental nature of organizational information processing."

Finally, Strassmann (1985) concludes that:

The cost of automating office is a matter of people not a matter of machines. OA projects are dominated by user costs, or organization cost. Due to heavy initial organizational costs, the benefits from most investment in IT can be realized in the long run. Realizing a long-term payoff from IT depends on the gain one obtains from people who learn how to work more effectively.

The primary objective of such projects is to rapidly make people much more productive. And do not automate obsolete patterns of work, because you will not get the full benefit of the technology. You will only get minor gains and minor gains soon will no longer be sufficient to maintain a competitive edge.

2. Effectiveness/Efficiency

Ives, et.al. (1983), state that:

> DSS can be judged on two criteria: efficiency and effectiveness. Efficiency deals with how well they do what they do. While effectiveness takes a broader focus. Are they doing the right thing? Are new computer technologies being successfully integrated into the organization?

Strassmann in (1985) "Making Office Systems Pay Off" (1985), prefers to measure effectiveness - doing the right thing. Effectiveness relates to the operation of groups, not individual, and effectiveness is judged by customer satisfaction. A higher level of payoffs come from improving group effectiveness and efficiency.

3. Payoffs/Costs

Strassmann (1985), states that:

> The goal of office automation from the point of view of many top managements, is to reduce employee headcount or to reduce direct expenses. These expenses include telephone charges, courier service, travel, etc. Management wants bottom line payoffs. Office automation can no longer be justified by promoting the use of technology with the vague claim that it will "increase productivity."

Levels of payoffs, There appears to be a progression of potential payoffs from installing office automation systems. The lowest level payoffs come from automating individual tasks, aimed at reducing head-count. These payoffs probably will not be great because they involve individual tasks and individual employees. A higher level of payoffs come from improving group effectiveness and efficiency.

Getting a financial payoff from automated office systems will not be easy. New technology, by itself, is not the answer. The big payoffs will come from solving the "people" problem.

Additionally, Strassmann in (1985) "The Real Cost of OA", identifies six cost and payoff characteristics associated with Office Automation (OA). The prime responsibility of management on information technology projects is to cope with organizational issues rather than with technology issues.

- Organized labor is becoming keenly aware of the negotiating leverage that mismanaged OA projects hand over to them.

- The cost of any activity that is labor intensive tends to rise faster than the general rate of inflation.

- Sending employees to classes on company time at a company training center is the most expensive way of learning.

- Most importantly, the risks of run-away organizational costs due to technical system failures cannot be tolerated.

- To create the right environment for sharing organization learning, it will be necessary to create new standards for access to information sources.

- Until we have better insights into the behavioral aspects of people, organizational costs will be high.

Olson and Lucas (1982), state that:

> The political view assumes that automation implies a division of labor that leads to decrease in skill, knowledge, and worker control over activities.

C. OTHER MODELS

This section discusses other models or perceptions collected in the nonempirical literature review. They are broken-down into pieces that address productivity, effectiveness/efficiency and other general perspective.

1. Productivity

Borko (1983) defines productivity as the ratio of the number of units of output to the number of units of input. Productivity can be measured by converting input and output units to their respective dollar equivalents. He further states that:

> Productivity rises when the number of units of output increases while input holds steady; or conversely, when the number of units of output remains fixed and the number of units of input decreased.

Obstacles to measuring knowledge worker productivity:

- Defining the nature, the value, and the unit of measure for the output of the knowledge worker.
- Tendency to deal with only the quantifiable and not with the quality of the outputs.
- The work done by a knowledge worker in a current time period may not show results until several periods later.

Carlyle (1987), states, "The difficulty of measuring productivity gains has also deterred potential buyers, but some vendors, like Texas Instruments, are in it for the long haul." He further notes that, at a time when the industry is paying lip service to the need for Computer Aided Software

Engineering (CASE), computerized tools for software developers are emerging ahead of an accepted productivity index or effective measure. Many large companies are afraid that they could invest more in trying to improve productivity than they would actually be able to save.

Mason, et.al. (1984) said, "In the area of public productivity and computer use, computers serve three purposes; reducing costs...increasing revenues...most important...providing better services."

2. Effectiveness/Efficiency

Hamilton and Chervany (1981), contend that, effectiveness is determined by comparing performance to objectives. The way to assess system effectiveness is to:

- Determine the task objective of the system or the organizational units [using] the system and to develop criterion measures to assess how well the objectives are being achieved.

System effectiveness is determined by attainment of a normative state, e.g., a standard for "good" practices. Effectiveness is conceptualized in terms of resource viability rather than in terms of specific task objectives. Evaluation of system effectiveness is difficult due to its multidimensionality, its quantitative and qualitative aspects and the multiple, and often conflicting, evaluator viewpoints.

The assessments of management information system effectiveness are often controversial and can be sources of disagreement and conflict between different functional groups involved in MIS implementation: users, management information system developers, internal auditors, and top management personnel. Maggiolini, (1986), identifies four points that can improve office automation technology efficiency by:

- Automating all or some parts of the office information process;
- Eliminating some of the transformations of medium;
- Eliminating or reducing the shadow activities/functions;
- Speeding up the information process itself.

3. General Perspective

Hamilton and Ives (1982), said that, "the key to good research, though is not just in choosing the right research strategy, but in asking the right questions and picking the most powerful method(s) for answering questions given the objectives, research setting and other salient factors." Ginzberg (1978), states that: The key point measure of effectiveness depends upon the intent of a project its goal. We can develop a behavioral measure of Operation Research/Effectiveness if we explicitly address the issue of goals at the start of the project. Finally, Strassmann (1976), suggests nine steps to better management of Management Information System:

a. Identify costs
b. Keep scores on unit costs
c. Establish standard costing
d. Set up accountability centers
e. Apply competitive pricing
f. Plan for the long term
g. Let the users control
h. Deemphasize the technology
i. Use job enlargement

III. METHODOLOGY

A. SELECTING STUDIES OF SYSTEM EFFECTIVENESS

1. Choosing a Medium from Which to Select Studies

Published articles were chosen as the source from which to select the studies of system effectiveness to be reviewed in this thesis. Published transactions of conferences were excluded for three reasons:

a. The difficulty of obtaining comprehensive bibliographical search coverage of all conferences that hold sessions related to system effectiveness. For example, an on-line bibliographic search of computer and management information system (MIS) failed to cover the important annual International Conference on Information Systems.

b. No evidence exists to support a decision that papers presented at a conference that publishes its transactions are superior to a conference that does not. Leaving aside the problems of obtaining reliable bibliographic coverage of conferences that do publish transactions, to include them would unfairly exclude papers from non-publishing conferences.

c. Both of the preceding issues are moot in that presenting a paper at a conference is, by convention, a step to submitting it for publication by a journal. Indeed, papers accepted by the editors of the International Conference on Information Systems convey the best of them to journal editors for consideration as published pieces (Gallegos,1985). In short, conference papers worthy of publication will appear in journal omitting conference papers prevents redundant entries.

2. Choosing Journals from Which to Select Studies

This review of academic studies began with a selection of journals from which reports of these studies would be taken. All reports of studies of system effectiveness in English-language journals in the field of management information systems (MIS) and the related field of management science were surveyed. We took as an authority for choosing this set of journals the works of Davis (1980), Hamilton and Ives (1983) and Vogel and Wetherbe (1984). A consensus of journal names from these studies yields the following list:

a. Academy of Management Journal
b. Accounting Review
c. ACM Computing Surveys*
d. Administrative Science Quarterly
e. Communications of the ACM
f. Data Base
g. Datamation
h. Decision Sciences
i. EDP Analyzer**
j. Harvard Business Review
k. IEEE Computer***
l. Information and Management
m. Interfaces
n. Journal of Management Information Systems
o. Journal of Systems Management
p. Management Information Systems Quarterly
q. Management Science
r. Omega
s. Sloan Management Review

* ACM: Association for Computing Machinery
** EDP: Electronic Data Processing
*** IEEE: Institute of Electronic and Electrical Engineering

Hereafter, this list is known as the consensus list. To it, was added Public Productivity Review which was discovered during a search for periodicals related to the issue of productivity. While the preferred publication outlets on the consensus list are refereed journals written by and for academic members of the MIS community, the list includes periodicals that are aimed at an audience of MIS practitioners and some that are not journals per se but are commercially published trade publications.

3. Choosing a Time Span from Which to Select Studies

The work on this review began in January, 1989 and was completed by June, 1989. The last journal articles that were considered for inclusion were published with the calendar period of 1988. 1970 was chosen as the beginning point for on-line and manual bibliographic searches.

However, no time limit was placed on inclusion of studies that were discovered by virtue of references in articles found in the 1970 to 1988 range by manual or on-line searches. The assumption was that articles worthy of inclusion that were published prior to 1970 would be referenced in articles published after 1970.

4. Searching for Studies of System Effectiveness

a. On-Line Bibliographic Search

In January, 1989, the Dialogueue access station in the Dudley Know Library of the Naval Postgraduate School was used for a bibliographic search based on key words in the titles and abstracts of articles. The following search key was constructed:

(Productivity or Effectiveness) and (Measures or Measurement or Assess or Assessment) and Information Systems.

This search identified 154 items that matched the search key. Abstracts on the 128 of these that were published in English were requested. Out of that set, 51 items were identified that dealt with the productivity or effectiveness of information systems. The other 77 items dealt with the monitoring of computer performance, productivity of software development or topics unrelated to system effectiveness but nevertheless included some combination of the search key words in their titles or abstracts.

Of the 51 items related to system effectiveness, 26 were conference papers. Out of the 25 items dealing with productivity or effectiveness of information systems that were journal papers, ten were in journals on the consensus list. This search covered several important conferences related to information systems, including some of which we would not otherwise have known.

Nonetheless, as mentioned earlier, the flagship MIS conference, the annual International Conference on Information Systems, was not represented. In retrospect, this on-line search was naive in its conception and incompetent in its execution. During the manual bibliographic search, it was discovered that the "productivity" and "effectiveness" keywords were scarcely comprehensive in the coverage of the literature of system effectiveness.

The keywords that authors in this literature applied to their works included:

- Cost
- Benefit

- Cost Benefit
- Evaluation
- Success
- Utilization
- Performance

Moreover, the search key applied only to Dialogue file 13, which is the INSPEC data base for the period from 1977 to 1988. That this file began its coverage at 1977 rather than 1970 already meant that the original intention was compromised. A different INSPEC file contained items published before 1977. That file would have been included in the search but for a funding limit on access to bibliographic search services.

Subsequent experimentation with on-line bibliographic searching revealed that other databases in the Dialogue set might have yielded more articles. Certainly, by not searching beyond the INSPEC file, which covers the computer and MIS fields, publications in fields such as general management (Harvard Business Review, Sloan Management Review) and management science (Management Science, Decision Science, Administrative Science Quarterly) were missed.

Because limited funding prevented further on-line bibliographic searching with a wider net of key words applied a broader set of databases, this study turned to manual searching.

b. Manual Bibliographic Search

We manually examined the Periodicals on the consensus list for the years 1970 to 1988 were manually examined (although some of these periodicals were founded after 1970). Indices of article titles for the covered years

were examined or every issue of a periodical (where indices were not available) were examined. The manual search sought titles of articles that seemed to deal with the effectiveness of information systems. This included articles on the performance of systems in specific industries or by type of specific application (such as decision support systems) as well as information systems in general. This effort yielded 93 articles purporting to deal with the measured effectiveness of information systems.

The manual search, not surprisingly, found the same ten titles that were revealed by the on-line search. The number of articles identified in the on-line search compared to the far greater number turned up by the manual effort was dismaying. This was the point at which it was discovered how hopelessly limited had been the key word synonyms for productivity and effectiveness that were used.

c. References from Journal Articles

Reference lists at the end of articles found manually were used to track down important works that either were published before 1970 or whose relevance was disguised by its titles. This procedure produced an additional 31 articles. These included works that dealt with system effectiveness as well as articles that dealt with productivity, cost-benefit analysis, organizational effectiveness and research methods that were written for a broader audience than the MIS discipline.

d. Gathering of Article Reference by Other Means

When studying a particular topic, a researcher becomes sensitized to its appearance in any form. Discussions of system effectiveness or productivity in popular or trade publications, that might otherwise go unnoticed, will now leap into a researcher's awareness. Even colleagues who are peripheral to a study become sensitized as well. They offer references and clippings dealing with productivity and the effectiveness of information systems. By these processes the inventory of works on productivity, system effectiveness and the measurement of effectiveness in this study was built.

A good deal of these were from popular and trade publications. They included magazine articles, newspaper items, student theses, books, transcripts of speeches and promotional literature on software and consulting services.

5. Sorting the Works on System Effectiveness

In combination, the preceding methods yielded an overall list of 118 references that was initially considered, by virtue of their titles, for review in this thesis. They are listed in Appendix A.

a. Empirical Studies

A reading of the 118 articles in Appendix A identified 45 empirical studies of system effectiveness. These 45 articles report empirical studies of the effectiveness of an information systems or an aspect of research techniques for studying system effectiveness.

These articles are distinguished from others in the original set of 118 in that they report findings based on data collected specifically for the study being reported. These are the studies that this thesis evaluates. They are studies

are listed in Appendix B. Among these 45 were articles that did not deal directly with a study of a system implementation but rather were concerned with the development of a research tool to study implementation success. These were retained because their study research techniques contributes to how we know what we know about system effectiveness.

Excluded from this review were studies that dealt with:

1. Computer performance.
2. Software development.
3. Other topics not related to information system effectiveness.

b. Non-Empirical Works About the Study of System Effectiveness

Excluded from this review of empirical studies were articles which did not report findings of a concrete study of a system implementation. These included essays on system effectiveness, literature reviews of system effectiveness or prescriptions for the methods of studying information system effectiveness. Appendix C lists the 22 articles in this group. They are, of course, the references that were discussed in the preceding chapter which reviewed the MIS literature on the assessment of system effectiveness.

c. Miscellaneous Literature

The remaining references from the initial 118 were categorized as:

- Popular and trade literature.
- Literature dealing with productivity or organizational effectiveness in general but not specifically related to MIS.

- Works dealing with research methodology without specific application to MIS.

These are listed in Appendix D.

B. REVIEWING THE EMPIRICAL STUDIES

The 45 empirical studies (listed in Appendix B) were individually evaluated for:

1. Design of data collection
2. Handling of threats to internal validity
3. Handling of threats to external validity
4. Time dimension
5. Data collection methods
6. Definition of effectiveness

1. Design of Data Collection

From a reading of the descriptions of research methodology and data collection techniques in each study, it can be determined if it:

a. Employed an explicit, experimental variable.

b. Gathered data before the administration of an experimental variable.

c. Gathered data after the administration of an experimental variable.

d. Gathered data from comparison groups at the same points in time.

e. Whether the membership in comparison groups was randomized.

Knowledge of these five elements permitted classification of each study according to its research design using the Campbell and Stanley (1966) taxonomy.

2. Handling Threats to Internal Validity

Once a study was classified according to the Campbell and Stanley taxonomy, it was possible to assess its ability to handle each of the threats to internal validity listed below:

a. History

A history effect involves events occurring between a pretest observation and a posttest observation which affect an observed phenomenon along with an intervening variable X. Designs that collect data at both pretest and posttest points but lack a parallel control group cannot control for the effect of history on a study's findings. Designs lacking a pretest point but involving a comparison group, while weak in other respects, can control for the effect of history.

b. Maturation

Maturation refers to changes within the respondents themselves that can account for differences in measurements between the first and second observations. As with the history effect, designs that collect data at both pretest and posttest points but lack a control group cannot control for the effect of maturation. Where a design lacks a pretest point but involves a comparison group, the capacity of the design to exclude maturation as a rival explanation of its findings in not clear from a design alone (as in the case of the static group design). Designs that use randomized comparison groups (such as the posttest only control group) are not affected.

c. Re-test Sophistication

Re-test sophistication arises when respondents become skilled at taking a test, filling out a questionnaire, answering in an interview or taking part in an experiment. As much as the intervening variable, such changes in skill can cause changes in readings at a second observation. Where a design lacks a pretest phase, yet uses comparison groups, this effect is controlled. Designs that involve a pretest and posttest but lack a comparison group (such as the one group pretest/posttest design) are threatened by re-test sophistication, For other designs, the effect is neither controlled nor threatening.

d. Instrument Calibration

Where people are the instruments of recording and measuring, changes within them can produce changes in the in reports of events. Examples of human re-calibration are fatigue, growing skill at conducting interviews, boredom or developing self confidence as observers. This effect is controlled in designs that involve comparison groups with randomized assignment of members or, lacking that, have no pretest stage. The one-group pretest/posttest design is vulnerable to instrument calibration effects.

e. Statistical Regression

Where comparison groups in a study of system implementation have been selected precisely for their extreme differences in scores on tests or surveys before a study, the statistical regression toward the means score is likely to occur on the posttest observation. Generally, respondents with extreme scores on one occasion will not produce the same extremes on another occasion. A design alone does not tell

whether statistical regression affects a particular instance of a one-group pretest/posttest design. The static group design, however, is vulnerable to is effect. Designs involving randomized comparison groups are able to control for the effect of regression.

f. Selection Bias

Selection bias is a rival explanation for a study's findings when comparison groups assumed to be equivalent are actually different due to biases operating during the selection of respondents. These differences can account for the differences in reported data between the two groups. Any design with a pretest and a posttest can control for this effect. Those lacking a pretest or a randomized comparison group are vulnerable to selection bias.

g. Respondent Mortality

Between non-randomized comparison groups, there can be a selective drop-out of participants from a study while researchers assume that dropping-out is random. This differential drop-out effect can account for differences in data reported from the groups. The designs that control for this effect and those that are vulnerable to it are identical to that of the effect of selection bias.

h. Selection-Maturation and Other Interactions

In multi-group research designs, the interaction of a selection bias with a maturation effect could be mistaken for the effect of an intervening experimental variable.

3. Handling Threats to External Validity

As with the threats to internal validity, knowledge of a study's placement in the Campbell and Stanley (1966) taxonomy of research designs allowed researchers to assess its capacity to exclude threats to external validity.

a. Interaction of Testing and an X Variable

In certain kinds of studies, the experience of participating in an experiment, completing a questionnaire, submitting to an interview or being observed at pretest stage sensitizes a group of respondents to an X variable. That is, by being subjects in a study, these people have a heightened sensitivity to an X stimulus that is not characteristic of the general population.

To that extent, the findings of such a study are not generalizable beyond the sample group. The one group pretest/posttest design and the true experimental design are both vulnerable to this effect. Groups that have some elements of non-pretest comparison such as the posttest only control group and the Solomon four-group design are able to control for it. Other designs are not affected either way.

b. Interaction of Selection and the X Variable

Campbell and Stanley (1966) use as an example of this threat a researcher seeking a school district to provide a sample of students for a study. Nine districts turn down the researcher. A tenth district agrees to participate. Surely, in some way, the tenth differs from the other nine. The results that this study yields will, therefore, not be generalizable to a large population of students <u>per se.</u>

To the extent that an experimental variable in this study has differential effects between an experimental group

and a control group, it is likely that characteristics of the school district caused the X variable to be more successful than it would begin other school districts.

c. Reactive Arrangements

The artificiality of an experimental setting or of questionnaire choices put respondents in a Guinea-pig, I-am-special role. Whatever behavior that is thereby observed or recorded does not represent how these same people are likely to act in everyday life.

d. Multiple X Interference

While a conventional research design involves a single administration of an X variable to experimental group, some quasi-experimental designs such as the equivalent time samples design, and the equivalent materials samples design, involve repeated administrations of an X variable to one group of respondents.

The trouble is that the effects of prior administrations remain with the respondents, building up with each subsequent administration. Such groups undergo an experience as research subjects that has few counterparts in everyday life. Thereby, they are rendered unrepresentative of the larger population.

4. Time Dimension

The Campbell and Stanley (1966) taxonomy of research designs also provides a means to assess whether a study has taken account of the time dimension as a basis for establishing causal inference.

Studies employing pretest and posttest observations and those that employ time series multiple observations, by

definition, account for the time dimension. Studies involving an observation at a single point in time do not.

5. Techniques of Data Collection

By convention, an empirical study is obliged to describe the technique by which it gathers data. That convention was upheld by all 45 of the studies reviewed here. Each study was classified according to the following taxonomy of data techniques:

a. Self-completion questionnaire, administered under the supervision of the researchers.

b. Self completion questionnaire, mailed out to subjects to be returned by mail.

c. Interview questionnaire.

d. Telephone interview.

e. Laboratory experiment.

f. Non-obtrusive technique: archival records.

g. Review of observations by expert panel.

6. Definition of System Effectiveness

Each study was read for its definition of how a system would be judged to be effective. No taxonomy of such definitions exists a priori The classification categories emerged in the process of reviewing the studies.

7. Degree of Change in Effectiveness Reported in the System

This thesis suggests that the appropriate enterprise for academic research in MIS effectiveness is the construction of a formal theory of system effectiveness. A theory of system effectiveness necessarily involves a knowledge of the determinants of such effectiveness. To understand the determinants of effectiveness, a researcher must know by how

much the effectiveness of an organization was improved or degraded by the implementation of an information system.

Therefore, it is appropriate to inquire as to the level of changes in effectiveness that are reported in each empirical study of system effectiveness. If doubts about the success of information systems are harbored by senior line managers, then a knowledge of the reality of information payoffs is a contributes to the current discussion. What do these 45 academic studies say about the successful application of information systems?

Each study was reviewed for indications of the level of reported changes in system effectiveness.

IV. FINDINGS

Appendix E contains an annotated description of each of the 45 studies evaluated here. Appendix F contains the detailed tables of findings for each aspect of the studies. The studies are listed in chronological order by date of publication.

A. DESIGN OF DATA COLLECTION

In Table F-1 (Appendix F), the number at designations at the top of the columns refer to evaluation elements in assigning each study to a design category according to the Campbell and Stanley (1966) taxonomy as follows:

1. The study collected data in a pretest stage.
2. The study employed a comparison group.
3. Respondents in the study were assigned to comparison groups on a randomized basis.

1. Non-Experimental Designs

a. *One-Shot Case Study*

Table 1 distills the distribution of research designs in these 45 studies out of the detail of Table F-1 (Appendix F). Table 1 shows that the one-shot case study is the research design of choice in MIS studies of system effectiveness, by a two to one margin. A one-shot case study has no explicit administration of an intervening, experimental variable (X). Rather, as the brackets around the X in the

design notation indicate, the subjects from whom data was collected, at the sole observation point O_1, were assumed to

TABLE 1

DISTRIBUTION OF RESEARCH DESIGNS*

Research Design:	Campbell & Stanley Design Notation	This Design as a Percentage of Studies Reviewed :
One Shot Case Study	[X] O_1	66.7%
Static Group Comparison	X O O	17.8%
One Group Pretest/Posttest	O_1 X O_2	4.4%
Experiment	R O X O R O O	4.4%
Posttest Only Control Group	R X O R O	4.4%
Time Series	O O X O O	2.2%

*These percentages sum to 99.9% due to rounding errors.

have been exposed to the effects of a non-existent experimental variable. In place of explicit exposure to an X experimental variable, the subjects at O_1 are asked to <u>recall</u> something. Human recall is notoriously unreliable (Haberman, 1963). For that reason, the one-shot case study

is "the weakest form ofsurvey design" (Denzin, 1970). Fundamental to the gathering of scientific evidence is the need for recording differences (Campbell and Stanley, 1966). Scientific testing requires the making of comparisons. No comparisons are made in one-shot studies. While one-shot studies often involve survey instruments that describe their face validity and Cronbach reliability indices in detail, all of that is a case of misplaced precision.

It is another case of shuffling the psychometric deck chairs on the methodological Andrea Doria. In the estimate of Campbell and Stanley, rival explanations for the findings reported by one-shot studies are so numerous as to render them nearly useless in establishing causal inference.

b. Static Group Comparison

As is shown in Table 1, the next most frequent design in MIS research on systems effectiveness is the static group comparison. This design offers the virtue of some basis for examining differences. The difficulty, however, is in attributing the differences to exposure to an experimental variable by one of the groups. That is because membership in the comparison groups in this design is not a randomized assignment.

The findings are vulnerable to the rival explanation that differences between the groups predated the intervention of an X variable. Where the comparison groups are deliberately selected for their extreme differences, as they were in some of the reviewed studies, the rival explanation gains potency. Another problem with the static group comparison is the possibility of biased drop-out by respondents in the period after the X variable intervened.

c. One Group Pretest/Posttest

The one-group design has the virtue of a deliberate attempt to measure the differences between a group observed at O_1 and at O_2. Unfortunately, its lack of a comparison group leaves it subject to a distracting set of rival explanations for its findings. Chief among them are other effects transpiring between O_1 and O_2 besides the X variable.

While it is superior to the one-shot case study, the only recognition the one-group design merited from Campbell and Stanley was that it was worth doing only where nothing better could be done. They employ the one-group as a bad example of research design that deludes researchers and their constituents alike by its closeness to a true experimental design.

2. Experimental Designs

a. True Experiment

The true experiment, having pretest and posttest data collection points paralleled by randomized comparison groups, controls for all threats to internal validity. The difficult with the MIS empirical studies of effectiveness is that only four percent of them used this design.

b. Posttest Only Control Group

While it lacks a pretest data collection stage, the posttest only design nonetheless qualifies as an experimental design by virtue of its randomized comparison groups. As with the true experiment, its difficulty is the rarity with which it was practiced in MIS research.

3. Quasi-Experimental Design

A quasi-experimental design, a description coined by Campbell and Stanley, is an attempt to approximate experimental design in a field setting by scheduling the whom and when of measurement even though the experimental variable itself is not amenable to scheduling.

a. Time Series

While it might appear that a time series design shared the vulnerabilities of the one-group pretest/posttest, this is not the case. The repeated measurements before and after an experimental variable controls for threats to internal validity such as maturation, re-test sophistication, instrument calibration, statistical regression and the interaction of selection bias and maturation. This renders it a much sounder design that the one-group. Regrettably, only 2% of the reviewed studies employed a time-series design.

B. HANDLING THREATS TO INTERNAL VALIDITY

The detailed evaluations of the handling of threats to internal validity by each of the 45 studies reviewed are shown in Table F-2 in Appendix F. A +1 in a column means that a study controlled the threat to internal validity represented by the column heading. A -1 indicates that a study was vulnerable to that particular threat. A question mark means that the effect of the threat upon this study cannot be determined solely by knowledge of the research design. No symbol indicates that a threat has no effect on the study in whose row it occurs.

Recall that internal validity asks whether reported findings are due to the effect of an experimental variable or result from causal factors not accounted for by the research.

Where a study can control threats to internal validity, its findings resist challenges to their scientific standing.

TABLE 2

THREATS TO INTERNAL VALIDITY

	Effect to Vulnerable	Effect Controlled	Effect Not clear	No effect
History	73%	27%		
Maturation	73%	9%	18%	
Testing	4%	29%		69%
Instrumentation	4%	27%	2%	67%
Regression		29%	4%	67%
Selection	84%	16%		
Mortality	84%	16%		
Interaction of Selection and Maturation	22%	11%		67%

To the extent that a study cannot exclude the rival explanations for its findings posed by threats to internal validity, the scientific meaning of the reported data will be lost. The evaluations in Table F-2 are summarized in Table 2. It reveals that, on average, slightly over 73% of the MIS studies of system effectiveness are vulnerable to the likelihood that their findings can alternatively be accounted for by the effects of history, maturation, selection bias and mortality.

This is a consequence of the fact that two-thirds of the MIS studies reviewed here employ a one-shot case study design.

No studies were clearly vulnerable to statistical regression as a rival explanation. Moreover, rather few (4%) had their internal validity threatened by re-test sophistication or instrument calibration.

The picture that emerges here is that of an academic discipline that cannot demonstrate with certainty that its empirical findings mean what they say. These findings erode a basis for establishing causal inference in the construction of a formal theory of the effective implementation of information systems.

C. HANDLING THREATS TO EXTERNAL VALIDITY

Table F-3 in Appendix F contains a detailed evaluation of the handling of threats to external validity by each of the 45 studies reviewed in this thesis. The column headings at the top of Table F-3 (to the right of the year column) includes the two external validity threats arising from interactions between the experimental variable and characteristics of a study's design.

The first of these is the interaction of re-testing and an X variable. The second is the interaction of selection bias and an X variable. The meaning of both of these are explained in Chapter III. The third column is the threat from reactive arrangements. The fourth is the threat from effect of multiple exposures to an X variable. The meaning of the +1, -1, ? symbols the same as in Table F-2.

Where internal validity asks whether the findings of a study can be trusted to mean what they claim, external validity deals with the extent to which the findings of a study are generalizable beyond the study to a larger population.

TABLE 3

HANDLING OF THREATS TO EXTERNAL VALIDITY

Threat	Effect to Vulner-able	Effect Cont-rolled	Effect Not clear	No effect
Interaction of Re-Testing with X Variable	11%	4%		85%
Interaction of Selection Bias with X Variable		89%		11%
Reactive Arrangements			16%	84%
Interference of Multiple Administrations of X Variable				100%

Table 3 summarizes the detailed evaluations of threats to external validity for each of the 45 empirical studies. The use of research designs in MIS empirical assessments determines these findings. With 11% of the reviewed studies employing a pretest stage, exactly 11% are found to have their generalizability threatened by a re-test effect. None of the reviewed studies involved repeated administrations of an X variable; therefore, none were vulnerable to multiple X interference.

However, the 89% of the studies that used non-experimental designs (chiefly one-shot case studies) precisely account for the vulnerability to an interaction of selection bias and an X variable. External validity deals less with a fundamental question of scientific credibility than it does with a simple question of relevance. Every study reviewed here is vulnerable to a challenge to the generalizability of its findings to a larger population. Only the two posttest-only

studies provided a positive control over any of the external validity threats.

If the findings of MIS research are not representative of any population beyond the studies themselves, the discipline is flirting with the likelihood that its core work is irrelevant beyond the pursuit of publication and tenure.

D. TIME DIMENSION

Table F-4 in Appendix F categorizes each of the 45 studies simply by whether its research design permitted an accounting of the time dimension in the collection of its data. 11% of the studies accounted for time, through designs such as the true experiment, one-group pretest/posttest and time series. The other 89% of the studies employ designs that collect data only at a single point. Most of those are of the one-shot case design. The capacity of a research effort to establish causal inference is impaired without a way to show that variable X occurs before variable Y.

E. DATA COLLECTION METHODS

Table F-5 (Appendix F) lists the type of data collection technique employed by each study. Two columns of methods are shown in Table F-5. One third of the studies in this review used two methods.

In some cases, two methods bolstered each other in an effort at triangulation. This happened where a survey questionnaire was used in conjunction with system performance data collected by the information system itself. In other instances, a first method was used as pilot study, usually for instrument development.

TABLE 4

DATA COLLECTION TECHNIQUES FOR PRIMARY METHOD

Asking Questions		73.3%
Questionnaire (Including mail out-mail back surveys: 22%)	60.0%	
Interview	11.1%	
Phone survey	2.2%	
Not Asking Questions		26.6%
Non-obtrusive methods (Archival)	17.8%	
Laboratory experiment	4.4%	
Diary	2.2%	
Panel	2.2%	

TABLE 5

DATA COLLECTION TECHNIQUES FOR SECONDARY METHOD

Asking Questions		80.1%
Questionnaire (Including mail out-mail back surveys: 27%)	66.7%	
Interview	6.7%	
Semantic Differential	6.7%	
Not Asking Questions		20.0%
Non-obtrusive methods (Archival)	13.3%	
Simulation	6.7%	

TABLE 6

DISTRIBUTION OF METHODS BY RESEARCH DESIGN

	Type of Research Design					
Method	One-Shot	Static Group	One Group	True Experiment	Post Test Only	Time Series
Questionnaire incl Mailed Out)	61.3%	71.4%	50.0%			100%
Mailed Out	29.0%		50.0%			
Interview	12.9%	14.3%				
Phone survey	3.2%					
Archival	16.1%	14.3%	50.0%			100%
Laboratory						100%
Diary	3.2%					
Panel	3.2%					
	100%*	100%	100%	100%	100%	100%

* Sums to 99.9% due to rounding error.

As Table 4 shows, over 73% of the studies reviewed here use primary methods that involve asking people questions whether by self-administered questionnaire (completed in group sessions or in a mailed-out/mailed back mode), personal interview or by phone interview.

The problem posed by this proportion is that the focus of inquiry is the effectiveness of systems, not of individuals. Even if the objection is made that systems, after all, are essentially comprised of people, then the fallacy of reductionism is in play. It is a fallacy to study a level of organization by reducing it to its constituents elements. If

reductionism were a valid approach to studying the performance of organizations or systems, why stop at individuals? Individuals, after all, are comprised of living organs. By this logic, we would study information systems by studying intestines.

One can follow this absurd path to molecular biology and beyond. While individuals together comprise systems (or groups or teams or organizations), there is a qualitative distinction between the analysis involved in studying individuals and in studying systems comprised of individuals. Systems (as with teams, groups, families or organizations) are not merely the sum of the discrete individuals.

Directing questions at individuals gathers data about individuals but collects little about the characteristics of the system. This leaves aside the even more troublesome issue about asking people questions even when it is individuals that are being studied. This preference for asking questions was even a bit stronger among the secondary methods.

The core concern with the people-asking methods is that the methods tend to create the very data they are recording. Far from providing a neutral, innocuous means of gathering observations about events, these methods provoke responses that, in themselves, involve role-playing, Guinea-pig effects, looking good, passing a test, socially desirable responses, fabrication, data inflation and otherwise carrying on in ways that are not found in everyday interactions other than with organizational or social superiors. These same biasing and distorting factors are found in the reactive setting of laboratory experiments. But there they are well known.

The trouble with the survey questionnaire is that it is assumed to have no biasing or distorting effects when it, in

reality is strongly biasing and distorting (Katz, 1942; Hyman, 1949; Wyatt and Campbell, 1950; Parry and Crossley, 1959; Robins, 1963; Williams, 1964; Weiss, 1968; Webb et.al, 1966; Sechrest, 1968; Summers and Hammonds, 1969; Hambright, 1969; Denzin, 1970; Phillips, 1971).

A final problem posed by the method of asking questions is that the data collected can only record the expression of attitudes. The asking-people methods are unable to record expressions of behavior. Behavior can only be observed or recorded by observers as archival data. While MIS researchers occasionally speak of dealing with "behavioral" issues or methods, in fact they are not dealing with behavior at all but attitudes.

To use a questionnaire to ask a respondent about their behavior is not to gather data on behavior. Rather the process gathers data on a respondent's attitude toward the behavior above which he or she is being asked. This is a distinction that seems largely lost on the MIS researchers in the study of system success.

Examining the association of method with research design holds no surprises. The non-experimental designs relied heavily on the methods that involve asking questions. But then so did all of the true experiments. However, the other experimental design, the posttest only control group, employed only a non-asking method. So did the single quasi-experimental design.

A strong relationship might be expected between a weak design such as a one-shot case study and a troublesome method such as asking questions of people. Both evince a reluctance to commit to research efforts that involve time series or attention to the details of non-obtrusive methods.

The discussions in many of the reviewed studies echoed the conventional wisdom that gathering data on the costs of an information system is difficult enough. Attempting to gather data on a system's benefits is regarded as futile. Thusly, these researchers justify turning to methods and designs noted more for their convenience than their scientific rigor.

If one has learned only survey methods as a graduate student, one is unlikely to explore alternative methods as junior faculty member under pressure to achieve tenure. This is especially the case where those alternative methods and designs take longer and are more difficult. Career expediency leaves causal inference in the dust. That the non-obtrusive archival data method is practiced so little is surprising in that it is in the nature of information systems to yield information even about their own performance.

Yet, archival data was employed as a primary method in fewer than 18% of the reviewed works (and as a secondary method in only 13%). As a non-obtrusive method, archival data offer the supreme advantage of having the least biasing or distorting effects.

F. DEFINITIONS OF EFFECTIVENESS

Table F-6 in Appendix F contains a list of the definition of system effectiveness gleaned from each reviewed study. These are combined and summarized in Table 7 below.

The first grouping, corporate scores, represents the traditional measures of success in the private sector. Among the reviewed studies, they are a minor fragment of the definitions employed for information success. The next traditional measure of system effectiveness, efficiency (cost reduction in this case) was found in 13% of the studies.

It is a definition how much under attack from the user attitude enthusiasts.

TABLE 7

DEFINITIONS OF EFFECTIVENESS FOR INFORMATION SYSTEMS

Corporate score		**4%**
Profit	2%	
Return on investment	2%	
Efficiency		**13%**
Cost reduction	13%	
Intermediate goods		**29%**
Information usage	5%	
Plan implementation	2%	
System usage	18%	
Job factors	2%	
Office automation	2%	
Effectiveness		**9%**
Decision quality	7%	
Performance factors	2%	
Value Assessment		**7%**
Value of information	5%	
System value	2%	
By-product		**34%**
User attitude	34%	
Miscellany		**2%**
Improved grammar	2%	

29% of the studies counted as a system output a factor that is actually a system input (described in Table IV-6 as an intermediate good). The mistake in these cases was to see the usage of information or a system as evidence of the system's success. The correct question is whether results from the usage, not the level of usage itself, benefit an organization. While there is much discussion in the MIS

literature on measurement about the need to focus on organizational effectiveness rather than conventional cost-cutting efficiency, only 9% of the reviewed studies employed effectiveness as a definition of success.

The major definition of system effectiveness found in these studies was some expression of user attitudes. This approach holds that if people say they are happy with a system then the system is a success. That seems sensible enough.

Yet, the popular and trade literature reviewed in Chapter I found that the payoff from information systems is either falling or not advancing commensurate with the investment made in it. A user's attitude about a system is an entity quite separate from the economic contribution of a system makes to an organization. The assumptions in this approach take either of these two forms:

1. A user is satisfied with a system that is productive. A user's satisfaction is a surrogate measure for a system's productivity.
2. Technical efficiency and economic contribution are not the point. At best, they are the means. User satisfaction is the end.

In the first case, the possibility exists that a user can be satisfied with an unproductive system. The satisfaction of a user may not necessarily be based on a system's efficiency but on other factors such as job-enlargement, better equipped work areas, learning of new skills or protection from redundancy.

In any case, system efficiency and performance must be examined apart from the attitude of users. It would, for example, be interesting to examine situations in which users were highly satisfied with unproductive information systems. That interest can be pursued only if satisfaction and system

performance remain distinct. The second case represents a matter of ideology, most often among the organizational development group that has emerged from organizational psychology. The root of the user-attitude definition of effectiveness may be methodological.

If a group is committed to the method of asking people, then the resulting answers are arrogated to an end. If you cannot measure effectiveness at the system level then it is expedient to dismiss it as a focus of inquiry. Can a formal theory of information system effectiveness be constructed on a foundation of attitudes about a system rather than measurements directly from a system itself?

G. REPORTED CHANGE IN SYSTEM EFFECTIVENESS

Table F-7 in Appendix F lists the level of change in organizational effectiveness, following the implementation of an information system, reported by each of the 45 empirical studies reviewed here.

In a group of studies that purport in some or way other to report findings of an inquiry into the success of information system, only 20% actually did so. A serious question arises as to whether MIS can construct a formal theory of system effectiveness when changes in effectiveness are not reported by 80% of its empirical efforts? When MIS claims to be studying system effectiveness yet has no findings related to it, MIS is in danger of gravitating into irrelevancy in the estimate of its major constituents: senior line managers, MIS practitioners and the general public.

V. CONCLUSIONS

A. PROBLEMS IN ESTABLISHING CAUSAL INFERENCE

1. Research Designs

Much of the concern about credible, appropriate research designs for the examination of the effectiveness of information systems has been treated in the previous chapter. A concern that still merits exercising is the proportion (two thirds) of the studies in this review that were of the one-shot case design.

According to Denzin (1970), the one shot approach makes no attempt to approximate the virtues of experimental design: no control, no control group, no time dimension. Rather, it simulates an experiment, not through design but, through analysis, specifically multivariate analysis.

This technique creates analytic groupings out of the collected data after the fact, groupings that the researcher should have been seeking initially. The underlying vulnerability of multivariate analysis is that any purported causal relationships are tentative due to the lack of a time dimension. Nagel concludes (1961) that the difficulties of basing causal inference on multivariate analysis "are notorious."

a. Internal Validity

73% of the studies reviewed here were vulnerable to alternative explanations of their findings because they could not control for the effects of history and subject maturation in their research designs. 84% were similarly

vulnerable to rival explanations of their findings because they couldn't control for the effects of selection bias and subject mortality in their designs.

Further, 22% of the studies were vulnerable to an interaction effect of selection bias and subject maturation. Another 4% of the works had their findings threatened by the effects of instrument calibration and re-test sophistication. Only four our of the 45 studies controlled all threats to internal validity: two true experiments and two posttest-only control groups. 91% of the reviewed studies were in a situation of having their findings open to one or more alternative explanations other than those reported by the researchers.

If this group of empirical examinations of system effectiveness cannot state, with confidence, that their findings are caused by the variables claimed by the researchers, but might well be caused by effects that were not controlled by the designs of the studies, then they lack a basis for establishing causal inference. They cannot be the foundation upon which a formal theory of information system effectiveness can be built.

b. External Validity

89% of the studies reviewed here were vulnerable to the possibility that their findings cannot be generalized to a population beyond their sample subjects because of the effect of selection bias interacting with the experimental variable. Their vulnerability to this effect is inherent in their research designs. 11% faced the same problem due to the effect of re-test sophistication interacting with the experimental variable. Only 4% of these studies were, by

virtue of their research designs, able to control for any of the threats to external validity. Out of the 45 studies reviewed, all were vulnerable to at least one of the threats to external validity.

While external validity does not directly affect the establishment of causal inference, it does raise the question of the relevancy of these research efforts if they do not reflect any segment of the real world beyond their own samples. Of how much value in the construction of a formal theory of system effectiveness will there be in studies that speak for nothing more than their own research arrangements?

3. Time Dimension

Out of the 45 studies reviewed in this thesis, 89% have no way to account for time due to the structure of their research designs. In the words of Denzin (1968), studies of this sort take a "snap shot" at one point in time and leave it to the respondent to weave a tale about events preceding the interview or questionnaire.

Causal inference requires that empirical findings be able to determine that a variable X preceded a variable Y in time in order to support the explanation that variance in X caused subsequent variance in Y. MIS assessments of system effectiveness lack this critical requirement for causal inference. Thereby they also lack another foundation for building a formal theory of system effectiveness.

4. Data Collection Techniques

More than two-thirds of the reviewed studies gathered data on system effectiveness variables by asking direct questions of human respondents, whether by self-completed

questionnaire, survey interviews or by phone. Fewer than a third used methods other than the direct asking of questions.

This renders the greatest part of the MIS studies of system effectiveness vulnerable to the possibility that the data they recorded reflects something other than the data that the researchers believe they collected. The direct asking of questions is a method that is obtrusive and socially demanding.

Questionnaires and interviews are suspected of creating the very data they record rather than recording data on events or processes external to the research act. As with internal validity, obtrusive methods raise the issue as to whether the reported findings of such studies are due to the causes claimed by the researchers.

a. Survey Research Problems

(1) Penetrating Language of Group Being Studied. Reliance on survey methods - whether self-administered questionnaires or personal interviews - raises a number of problems. First is that the interviewer or the writer of the questionnaire must penetrate the language and symbols of the group being studied (Denzin, 1970). Otherwise, the interview or the questionnaire are carried out in a relationship in which the researcher interacts with the respondents as strangers (Denzin, 1968). This is a process readily appreciated by anthropologists undertaking to study an alien culture. It is a process ignored by academics pursuing the study of a group that <u>seems</u> to be less remote. The assumption by MIS academics that the languages and meanings used by their subjects are already known is a fatal conceit.

(2) Differential Status of Respondents. A second problem - for which there was no evident concern in the studies reviewed here - is that different individuals within a group occupy different social positions in a group itself. Consequently, their perspectives on the group and its success or failures will vary by position. The apparent operating assumption in these studies was that members of a group are essentially interchangeable parts. Each represents the group through undifferentiated expressions. This has the effect of yielding responses that are actually quite different from what the researchers believe they are gathering.

(3) Obtrusive Nature of Survey in Everyday Life. A third problem concerns the interaction between the questionnaire or the interviewer and the respondent. The operating assumption in the reviewed studies seems to be that the questionnaire or the interview is neutral, eliciting a straightforward recitation of facts or of opinions not influenced by the question-asking act itself.

In actuality, the opposite is the case. Respondents are anything but straightforward with question askers. This involves socioeconomic, cultural, ethnic or organizational status differences between researchers and subjects. Male and female differences is a common source of constrained reporting by respondents (Denzin, 1970). So are racial differences. These act to create responses out of the interaction itself rather than collect data on a phenomenon outside the interaction such as, say, systems effectiveness.

(4) Social Definition of the Research Process. A fourth problem is that the researchers, the topics, the respondents, the questions, the answers, the setting, and even the questionnaire form are objects within a research interaction. Their meaning is not objectively defined outside of, or prior to, the research act. Rather, the social definition of these objects takes place as a negotiation process within the interaction. This is a process about which the researchers in this review showed no awareness.

Again, the data collected may not provide an accurate basis for the findings claimed by the researchers. As they are described by Reciting (1966), "interviews and questionnaires intrude as a foreign element into the social setting they would describe, they create as well as measure attitudes." Research methods, as Denzin (1968) argues, are not "sterile a theoretical tools."

(5) Role taking in Survey Responses. A fifth problem concerns the credibility of survey responses. As was discussed in Chapter IV, people take roles with respect to questions. They are vulnerable to Guinea-Pig effects and to taking on roles such as antagonist, sympathizer, helper, test-taker, informant, protector, participant in a scientific endeavor or spokesperson for a group (answering not for themselves personally but for an imagined collectivity).

These roles put a respondent in a frame of mind other than that of a straightforward provider of research questions. The latter is probably the very role not taken up by respondents. Yet, straightforward provider of answers is the only role believed to be presented by survey researchers. The result is that the data collected by surveys means are

something other than what the researchers believe them to be. Researchers analyze these data and report them without any suggestion that they are affected by the very process of collecting the data.

(6) Social Desirability Effect. A sixth problem is social desirability. This takes place within the interaction between a respondent and an interviewer or a questionnaire (where the responses are not anonymous or not believed to be truly anonymous). In North America, and possibly Western Europe, a respondent gives answers that would be socially acceptable by a standard known to the respondent (usually middle class norms if they are of the middle or lower classes).

In the United States, respondents usually wish to present themselves as happy, mentally healthy, educated and prosperous. While interview schedules and questionnaires can be constructed to detect and discount socially desirable responses, there was no indication that this problem was dealt with in any of the reviewed studies.

(7) Fallacy of Reductionism. A seventh problem with the survey method is that it necessarily gathers data from individuals. Missing are data about social aggregates such as organizations, groups, teams or systems. In that these 45 reviewed studies purport in some way to examine the effects of information systems, it would seem appropriate that the data collection would focus on systems per se.

What these researchers, did instead, was to focus on individuals, thereby indulging the fallacy of reductionism: that a functioning whole is the same entity as the sum of its component units. This is, in the view of

Wertheimer (1950), a crucial problem in social research in which functional wholes have not been defined as systems the behavior of which is not determined by that of their individual elements.

A metaphor suggested by Mill (1879) says that, "the different actions of a chemical compound will never be found to be the sums of actions of its separate parts." According to Nagel (1961) functional wholes are systems which cannot be built up out of elements by combining the latter. A functional whole cannot be properly analyzed from an additive point of view. A whole cannot be inferred from properties displayed by its constituents in isolation from the whole.

Coleman (1958) complained that no matter how numerous the correlations, how complex the analysis, survey studies focus on individuals. They tend to be, in his phrase, no more than "aggregate psychology." What these studies miss are the relationships between individuals. They show nothing about the interactions between people.

(8) Inability to Measure Behavior. An eighth problem with the survey method is that it is inherently unable to measure behavior. It can only record attitudes. As discussed in the previous chapter, a survey that asks questions about behavior can only record a person's attitudes about the questioned behavior; a survey cannot show the actual behavior. This is because, as Denzin points out (1968), the emphasis on "respondent reconstruction" of past events, the survey is destined to gather data only on attitudes and not behavior.

Coleman (1969) described this as a shortcut taken by most researchers. The study of behavior requires observation (watching, participating or experiencing) or recording of behavior (archival records, audio tapes, video tapes, films). This requires time. It requires equipment. It requires digging through records. It requires theoretical sampling (Denzin, 1970) of the places where the behavior will take place. The convenient assumption behind attitudinal research is that there is a connection between attitudes and behavior; to wit, attitudes cause behaviors.

While there is evidence that behaviors lead to the development of attitudes, showing that the causality runs from attitude to behavior has been problematic (Denzin, 1968). On the contrary, evidence has accumulated showing that accurate prediction of behavior from measures of attitudes is not possible with the methods now employed (Tittle and Hill, 1967).

Studying behavior takes a greater commitment to scientific endeavor than is typically required for a one-shot design, mail-out questionnaire. Therefore, what is observed in these 45 studies, and throughout the general practice of research in management topics, is a gravitation to expediency: the convenience, the speed, the low cost of the survey method.

In summary, the survey fails to meet even the minimal assumptions for an adequate methodology (Denzin, 1968).

b. Questionnaire Problems

(1) Fixity of Questions. In addition to the preceding problems of surveys generally that afflict questionnaires as well as interviews, questionnaire schedules have additional problems peculiar to their usage. The reviewed studies that employed questionnaires reported that they were of the standardized schedule type. That is, respondents were presented with a fixed set of questions and a preconceived, precoded, finite set of response possibilities.

The result of this rigid approach was to generate numbers, through the questionnaire process, about what was on a researchers mind when the questions were written. It is a process that taps little of what is on respondents' minds. The likelihood is that the response to the indifference of questionnaire fixity is simply fabrication (Denzin, 1970).

(2) Construction of Scales. A second problem that is endemic to the questionnaire is the matter of constructing scales. The assumption behind the construction of scales on attitudinal questionnaires, such as Likert-type instruments, is, as Denzin explains it (1970), "that an underlying attitude variable is being measured. The scores for any respondent are assumed to represent his position on the latent dimension and the items are assumed to reflect that dimension."

Whether the assumption is upheld empirically is problematic for all questionnaires using scaled responses for indications of attitudes or opinions. The difficulty is that no single indicator can cover all dimensions of a variable (Denzin 1970). A single indicator has only a probability

relation to what it is that a researcher actually seeks to know.

(3) Mail Out - Mail Back Problems. A problem that plagues the mail out-mail back self-completed questionnaire is that nothing is known about the characteristics of the people who did not return a questionnaire. This leaves this technique vulnerable to the internal validity problem of bias in the selection of respondents. A face-to-face encounter between question asker and respondent can, and often does, involve a "break off" by a respondent. That is, a respondent suddenly declines to participate.

The question asker in these situations at least has the possibility of gathering some indications of a refuser's age, sex, race or other obvious characteristics. Not so the researcher using mail back responses. The chief virtue of the mail out-mail back technique is that is cheap and easy. It is not a means for gathering data that will contribute to the building of formal theory.

5. Definitions of System Effectiveness

The definitions of system effectiveness gleaned from these 45 studies tell a great deal about what is taking place in the endeavors of academic MIS to measure the performance of systems. The field has polarized into two schools of thought: cost-benefit analysis and user attitudes.

Actually, it is less a case of polarization than it is of the aggressive user-attitude camp driving cost-benefit into retreat. The user-attitude enthusiasts view do not care if their definition of system effectiveness as a resultant of scientific endeavor. For them it is a matter of ideology.

The user-attitudinalists characterize the use cost-benefit analysis as discredited, traditional and infeasible. They view user attitudes as modern, feasible and appropriate. Their argument, to recall the discussion in the previous chapter, is that while data can be gathered on costs, nothing can be gathered about benefits. Benefits of information systems are so lacking in tangibility as to be rendered useless as a way to analyze effectiveness.

Cost-benefit analysis was appropriate for massive, batch-processed transactions on mainframe systems. They are part these measures of the cost-reduction efficiency mentality. What value can have, the attitudinalists ask, when we are examining the effectiveness of, say, a microcomputer-based decision support system?

In the latter case, the emphasis is not upon efficiency but upon effectiveness. It is not upon quantity and cost but upon quality. Therefore, the very advancement of hardware technology and the evolution of software systems have rendered cost-benefit analysis as deficient and inappropriate.

The only remaining issue, in the minds of the attitudinalists, is which particular attitudinal questionnaire, and which specific question items, are best suited to gauge user satisfaction. That, indeed, is the focus of their research endeavors. Not the construction of a formal theory of system effectiveness but the fine-tuning of the ultimate questionnaire.

Left out of this approach are any indicators of the actual productivity that arises from a system where efficiency is the issue or the actual effectiveness of a new system where that is the issue. Missing are measures of actual

productivity as distinct from users' opinions about productivity.

As the discussion of this issue in the last chapter indicated, there is good reason to believe that the conceits of the attitudinalists about the superiority of their formulation of system success is, in reality. A fig leave covering their methodological nakedness. As graduate students, one suspects, they invested in learning the prevailing but deficient survey method employing standardized Likert-scaled questionnaires in mail out techniques operating under one-shot case designs.

The opportunity cost of having learned that approach has been an ignorance of other approaches. The attitudinalists are not only ignorant of alternative approaches, they are ignorant of the problems and deficiencies of their own methods.

These suspicions about, and characterizations, of the user-attitudinalists would be no more than material for empirical testing and academic contention were it not for their own aggression. Not content to demonstrate that their way might be better, they attack alternative concepts of the effectiveness of information systems. They force practitioners of cost-benefit analysis into a defensive posture.

At the very least, they make difficult an attempt to reconcile different views of effectiveness. If the concept of efficiency cannot be entered into the dominant dialogue about system performance, it cannot be compared or combined with user attitudes.

B. INTELLECTUAL FOUNDATIONS OF MIS

1. Failure to Establish Causal Inference

The choice of research designs, the vulnerability to threats to internal validity, the lack of accounting for a time dimension and the choice of data collection methods - considered separately and taken together - in the MIS empirical assessments of information system effectiveness provide no grounds for establishing causal inference.

2. Inability to Build Formal Theory

The inability to establish causal inference in MIS studies of systems removes a foundation for building a formal theory of system effectiveness. By derivation, it further removes one basis for constructing a formal theory of information systems. Not to construct theory is to miss the point of academic endeavor. In the words of Nagel (1961), "the paramount aim of theoretical social science is to establish general laws which can serve as instruments for systematic explanation and dependable prediction."

3. A Discipline without Theory

MIS is an academic discipline that cannot construct formal theory about its essential concerns. Its has put itself in the position of being unable to adequately describe, explain or predict the very matters that justify its existence. It has traded the pursuit of explanation and prediction for the pursuit of career security. Publication is pursued as a means to tenure rather than as a means to supporting MIS practitioners. A gulf will widen between the academic world of MIS and the practitioner world of MIS. Thereby, does academic MIS flirt with irrelevancy.

VI. RECOMMENDATIONS

A. FOR MANAGERS AND COMMANDERS

1. The Cost of What Is Not Known About Information Systems

The United States Navy has hundreds of thousands of desk-top microcomputers. The very number provokes a concern as to how efficiently or effectively they are being used, a concern that emanates from high levels in the Navy. Read Admiral Paul Tobin, the U.S. Navy's chief of data automation systems, wondered aloud recently how many of the Navy's desktop machines were being used. He was quoted in Federal Computer Week as saying, "Let's make sure we're using our tools. In some way the system has gotten ahead of the users. [We] have to figure out how to do more [with the basic systems]" (Brewin, 1989).

Senior military officials, much like senior corporate executives, encounter difficulties in dealing with the world of information technology. Senior officials often have little grasp of the technology of computers. They know that information systems can be used to strategic advantage but they are at a loss to transform their wishes into successful implementations. Therefore some officials delay information technology decisions. Others avoid them altogether. Still others take the opposite tack and blindly provide a blank check for the purchase of information systems, especially microcomputer-based systems, without a clear expectation of

the return they expect, the results they want or how to measure the effect of what they getting.

Admiral Tobin has summarized what most observers of the approach by the U.S. military to the new information technology already know: money has been thrown at hardware and software in the past decade without a sense of what was wanted or of what was achieved. That is not the same thing as saying that the U.S. military has received no return for its expenditures. Only that (1) it is unknown what was achieved and that (2) consequent achievements will have been the result of good fortune and the dedication of field level activity system-enthusiasts rather than as the result of planning.

A good deal of our alleged low productivity and low payoff from information systems, especially office automation, is due in large part precisely to the generous but unscrutinized funding for microcomputer-based information technology. Millions have been spent on computers, peripherals, supplies, environments and training without the hard review that would be given to a turret lathe costing only thousands. A lack of scrutiny before the office automation funding frenzy has generated more managerial remorse than office productivity. In hindsight, managers and commanders are asking, "Where is the computer payoff?"

This discussion assumes, of course, that senior officials truly seek to measure system performance to find their payoff. It would be understandable if some officials did not want to discover the truth about the productivity of office automation. After all, if you have lavished funds on desk top computing or information centers, the last thing you want to do well or accurately is a study of exactly how much productivity was or was not thereby enhanced.

2. Becoming Informed Consumers of Information Technology

In the world of MIS, there exist a division of labor between practicing managers and MIS academics. Managers need academic MIS to develop scientifically credible ways to describe, explain and predict the working of MIS. Managers can't do. It is the job of academic MIS. However, it won't get done if managers indulge the inadequate research methods of academic MIS.

Managers and commanders must re-acquaint themselves with the requirements for credible research. They must be science literate. They must become informed consumers of academic MIS studies of such matters as system effectiveness. They must be able to know when reported research results are scientifically sound. They must beware of the easy dismissal of cost benefit analysis and economic analysis by MIS researchers from the user attitude school of effectiveness. Managers must be clear about the distinction between an effective system and people's perceptions of an effective system.

Specifically, managers, as consumers of research must beware of studies that purport to assess system effectiveness by using attitude questionnaires to gauge system outputs as well as system inputs. Attitude questionnaires are consistent; they exhibit high correlation coefficients within their own domains. The trouble is in relating attitudinal scores to independent, external grounding in behavior.

Where MIS researchers deny that data can be gathered on system benefits (too intangible they say), it is not only possible to gather such data, it is relatively easy.

A further burden that falls to managerial consumers of MIS research is to grasp the place of theory. Managers

must not let their own action-oriented, practical mindsets mislead them into an impatience with the critical need for formal theories in MIS. Managers and commanders must ask whether the research results they read are part of an effort to build theories that can describe, explain and predict MIS system effectiveness. If not, what are the researchers trying to do? Are they simply doing studies to gain academic tenure?

If managers sense that academic MIS, as represented by research reports in academic MIS publications, have no relevance to their work, they must make that clear to the MIS academics. Unfortunately, managerial MIS does not pay for academic MIS directly. The income of academic MIS is not dependent upon the pleasure of practicing MIS. This structure of third party financing of research allows MIS academics to be distracted from the construction of theory into the expedient pursuit of careers.

However, MIS practitioners do provide academic MIS with its legitimation, its reason for existing. Legitimation is not a strong control in the short run. In the long run, without acceptance by practicing MIS, academic MIS is irrelevant.

This situation is different in the interface between MIS managers in the defense community and academic MIS researchers attached to defense educational institutions. There, the practitioners provide not only legitimation but also research funding.

MIS academics in the defense community are held accountable for their research results. While this control possibility is not perfectly exercised, its potential is large for disciplining academic MIS research.

B. FOR THE STUDY OF SYSTEM EFFECTIVENESS

1. Research Designs

a. Time Dimension

Until MIS research designs for studying system effectiveness account for the time dimension, they will lack any basis for causal inference (Vitalari, 1985). All MIS research designs must gather data at more than a single point in time. The portion of the MIS studies that have no concern with time in system assessment (now 89%) must be reduced below 25% in the next decade. Otherwise, MIS research may fail to establish scientific credibility. MIS researchers must abandon cross-sectional analysis designs in favor of longitudinal designs.

b. Randomized Comparison Groups

As Nagel (1961) noted, it is possible to advance scientifically without meeting the full requirements of a true experiment, yet some form of controlled investigation "appears to be indispensable." To that end, MIS researchers must not only employ comparison groups in research designs (which 27% of the reviewed studies did) but use comparison groups with randomized assignment of respondents.

Only by that means can MIS research control for the threats to internal validity arising from history, subject maturation, re-test sophistication, instrument calibration, statistical regression, selection bias, respondent mortality and the interaction of selection bias and subject maturation. Only then can MIS research build a confidence that its findings actually reflect what MIS researchers intend instead of being open to rival explanations by effects which were not taken account of in the research designs.

c. Quasi-Experimental Designs

While a great deal can be learned from laboratory experiments, the rich and fruitful MIS research of the future will be done in field settings. Most of it already is (96% of the reviewed studies were done in field settings). The difficulty is that the experimental virtues of repeated measures with randomized controls are not now being approximated.

The route to gaining the richness of field setting research with the rigor of experimental controls is quasi-experimental research designs (Campbell and Stanley, 1966). MIS researchers must first declare the experimental variable they are examining. They must then gather data before the application of an X variable and again after. They should make longitudinal (multiple observations), especially in the posttest phase. This is not a difficult requirement. It can be accomplished with survey methods as well as with unobtrusive methods. The beauty of this approach is that information systems inherently produce data on key variables that a researcher into system effectiveness will want to measure.

To compare organizational functioning in a manual work mode with that in a post-implementation mode, researchers must commit to digging through accounting and other organizational, hard-copy archives. In the post-implementation phase, they can then indulge the relative luxury of having the system being studied provide the data.

For an example of this technique see the one-group pretest/posttest study of a standardized contracting and purchasing system by Barclift and Linson (1988).

2. Triangulation

Triangulation is amply illustrated by the proverb of the blind men reporting on the characteristics of an elephant. Each man reported different characteristics, depending on whether he was making a tactile examination of the trunk, tusks, legs or tail. The situation is much the same in MIS research. Each researcher, employing a single method of data collection, a non-experimental design and a single theoretical position on the nature of system effectiveness is little better than a blind man. Only conceits and psychic investments in current methods keep MIS researchers from appreciating the limits of their empirical insights.

When the proverbial blind men can compare, contrast and locate their findings, they open the potential to describing the illusive reality of the elephant. Once MIS researchers use multiple methods of data collection, multiple observation points in time, multiple comparison groups and multiple forms of data then they, too, will be open to the rounded, realistic description of the demonstrated (rather than the assumed) effectiveness of information systems.

a. Triangulation of Data

(1) Triangulation of Time. Of the reviewed studies, specification of time was inadequate. The most specific mention was the year in which data were collected. Beyond that, no attention was given to the timing of data collection. Triangulation of time would require data collection with these variations: different times of year, different times within a month (a great deal of information system activity has a monthly cycle), different days of a week and different times during a day (this is a potent but

neglected avenue of research into, for example, the way a night shift crew uses a hospital information system without the support of daytime MIS staff).

Not all of these variations may be relevant to any particular examination of an information system. However, the likelihood is that one of them will profoundly affect the data gathered from any one type of information system.

(2) Triangulation of Place. All human activity has a spatial designation. Many of the reviewed studies noted the organizational location of their data collection that often implied a geographical variation. Yet, spatial differences were not introduced consciously as a variable. Space differences are attended to cross-cultural comparisons, but cross-cultural comparisons have not been a part of system effectiveness inquiries.

The temptation in MIS research is to assume that place is irrelevant without further consideration. The conceit is that influence of information technology overcomes differences in time, culture or place. But does it? Do studies exist that establish that spatial location can be excluded as a critical independent variable? No. Instead, place is conveniently assumed away: information is information.

Yet, information is an object in our lives subject to the same, situated negotiations among interacting people as any other object (Boland, 1985). The influence of spatial location is an empirical question; until its effect is deliberately examined, it cannot be assumed away.

(3) Triangulation of Level of Data. This thesis has already exclaimed upon the need to move MIS studies on system effectiveness away from data collected from individuals to data collected about systems and organizations. A triangulation of data would require that any study of systems performance include data from three levels: (a) individuals (which MIS studies now gather in abundance and to the exclusion of other levels of data), (b) systems (departments, teams, shifts, and true systems of people who are connected in relationships that are built around producing an output through the mediation of hardware and software of their information technology no matter what their formal organizational identities) and (c) interactions (the encounters, negotiations, definitions, avoidances, competitions, cooperations, and coordinations between individuals or groups but not characteristics of the people or the groups per se).

b. Triangulation of Theories

To speak of triangulating theoretical explanations of system effectiveness is premature in a discipline that has not developed a formal theory nor is presently able to do so. Yet, we have emerging, competing schools of thought as to how the concept of system effectiveness should be defined. Any study of system effectiveness ought, therefore, to approach an empirical assessment with more than one concept of effectiveness.

A system's performance must be studied in terms of user attitudes. At the same time it must be studied in terms of costs and benefits. Further, it must be studied in terms of the economic value of information.

And, finally (without exhausting the MIS inventory of concepts of system effectiveness), it must be studied in terms of organizational effectiveness.

c. Triangulation of Methods

Survey researchers already employ a variant of methodological triangulation - within-method triangulation (Denzin, 1970). They use various scales and multiple standardized schedules to tap attitudes they are examining. The limit here is that this takes place within a single method. This leads researchers to congratulate themselves on the breadth of their methodological labors while deluding themselves that variations on the same method produce distinct viewpoints. According to Webb (1966), each method is imprisoned within its own biases and distortions. Combining within-method variations is a first step but it cannot be the only step.

What is required of MIS research is the combination of methods to study the same system or the same phenomenon. Thereby will the strengths of one method compensate for the weaknesses of another. The effectiveness of a information system implementation can easily be assessed using unobtrusive measures as well as, say, attitudinal questionnaires as Barclift and Linson (1988) did.

The greatest benefit of between-method triangulation is countering rival explanations for reported findings that arise from reactive arrangements. The reactive effects of questionnaires and interviews on data were discussed in the previous two chapters. In an ideal strategy, MIS researchers will combine survey questionnaires, personal interviews, archival data, system-generated measures,

participant observations and phenomenological techniques (Webb, 1966; Denzin, 1970; Boland, 1985).

3. Long Term Field Studies

Even with a recommendation for accounting for a time dimension and for triangulating for time as a data variable, the preceding discussion has been framed in the assumption of a relatively short term research project measured from months to as long as two years. Covering the implementation of an information system, from system proposal to final, post-training full implementation could easily cover two to three years. But MIS research must commit to going beyond that.

Once the introduction of a system has been assessed, MIS researchers must continue with follow-up studies through the life cycle of a system. Considering that the useful life cycle of some information systems is quite short (most are shorter than a decade and some scarcely last three years before succumbing to obsolescence), this is not a burden. Once entry has been made to an organization to study its information systems, the greatest hurdle is past. Unless MIS researchers have a propensity to be wearisome to their hosts and wear out their welcomes, they must extend their research relationships for a long view.

The payoff form this is that different things happen to information system in the long term than are ever imagined in the short term. The most potent revelations in social research have come from the longest studies: communities, organizations, cohorts of people over a lifetime. The same will be true with MIS topics. In their examination of the introduction of a productivity-enhancing system that cut contact-processing time in a U.S. Army installation, Linson

and Barclift (1988) suggested that follow-on research was needed to see if the short term efficiency, in itself, would provoked user activities to make greater demands on the system in the years ahead.

4. Unobtrusive Measures

A theme that has been exercised in the fourth and fifth chapters of this thesis, and echoed earlier in this chapter, is the distorting, biasing effects of the survey method. This leads to a recommendation for MIS research to embrace the methodological point of Webb at al (1966), for the use of data collection techniques that are not reactive - that is, that do not lead to role-playing, fabrication, social desireable response and other behaviors that arise in the research interaction.

This recommendation is for the use of nonreactive data sources, specifically archival data sources. This recommendation is particularly appropriate to MIS research because the production of information is the point of information systems. Some of that information reflects the performance of the system itself. This does not mean the technological monitoring of hardware system in terms of processor clock speed or input/output efficiency. Rather, it means the use of organizational accounting data on costs, production and outputs.

An argument will arise from the user-attitudinalists that the archival data produced by information systems will miss the intangible benefits of an information system such as higher morale. Once again this reflects an investment in a single method rather than the reality of available data.

One approach to measuring morale is to use attitude questionnaires that purport to assess it. But only attitudes will be assessed. Do the attitudes inform the behavior of people? Does it direct what they actually do? As an example of an alternative measure of morale, examine organization records for the classic workplace-safety-valve for people who are unhappy with their jobs: sick leave (Barclift and Linson, 1966). When people are truly are fed up with their work, especially people below the managerial or professional levels, they avoid the workplace by staying home and calling in sick. Or, they drive themselves into actual symptoms of illness produced from anxiety and job stress. Why then must an attitude questionnaire by employed exclusively to assess morale when a powerful, triangulating behavioral measure is so available?

APPENDIX A

ALL ARTICLES IDENTIFIED AS DEALING WITH STUDY OF SYSTEM EFFECTIVENESS

Adler, Paul S., "A Plant Productivity Measure for "High-Tech" Manufacturing," Interfaces, vol. 17, no. 6, pp. 75-85, November-December 1987.

Ahituv, Niv, "A Systematic Approach Toward Assessing The Value on Information System," MIS Quarterly, vol. 9, no. 4, pp. 65-75, December 1980.

Aldag, Ramon J. and Daniel J. Power, "An Empirical Assessment of Computer Assisted Decision Analysis," Decision Sciences, vol. 17, no. 14, pp. 572-588, Fall 1986.

Altmeyer, Ann S and Lisle S. Bozeman, "Productivity via Computer Technology," Public Productivity Review, vol. 5, no. 4, December 1981.

Amirrezvani, Anita, "Plumbing the Corporate Pipeline," Data Base, pp. 174, August 1986.

Anthony, Michael G., "IEs Measure Work, Write Standards For White Collar Workers At Financial Institution," /IE/, pp. 77-81, January 1984.

Baily, James E., "Development of A Tool for Measuring and Analyzing Computer User Satisfaction," Management Sciences, vol. 29, no. 5, pp. 530-545, May 1983.

Ball, Leslie D., "Increasing the Manager's Productivity Through the Information System," Public Productivity Review, vol. 4, No. 1, pp. 51-62, March 1980.

Barkin, Stephen R. and Garry W. Dickson, "An Investigation of Information System Utilization," Information and Management, vol. 6, no. 1, pp. 35-45, December 1977.

Baroudi, Jack J., Margrethe H. Olson and Blake Ives, "An Empirical Study of the Impact of User Involvement on System Usage and Information Satisfaction," Communication of the ACM, vol. 29, no. 3, pp. 232-238, March 1986.

Baroudi, Jack J. and Wanda J. Orlikowski, "A Short-Form Measure of User Information Satisfaction: A Psychometric Evaluation and Notes on Use," Journal of MIS, vol. 4, no. 4, pp. 44-59, Spring 1988.

Bolte, Keith A., "Intel's War for White-Collar Productivity," National Productivity Review, pp. 46-53, Winter 1983-84.

Borko, Harold, "Information and Knowledge Worker Productivity," Information Processing Management, vol. 19, no. 4, pp. 203-212, 1983.

Bowen, William, "The Puny Payoff From Office Computer," Fortune, pp. 20-24, May 26th, 1986.

Bruwer, P.J.S., "A Descriptive Model of Success for Computer-Based Information Systems," Information and Management, vol. 1, no. 2, pp. 63-67, July 1984.

Buller, Paul F. and Cecil H. Bell Jr., "Effects of Team Building and Goal Setting on Productivity: A Field Experiment," Academy of Management Journal, vol. 29, no. 2, pp. 305-328, June 1986.

Buss, Martin D. J., "Pennywise Apporach to Data Processing," Harvard Business Review, vol. 59, no. 4, pp. 111-117, July-August 1981.

Calista, Donald J., "Microcomputer Applications to Productivity Improvements," Public Productivity Review, vol. 9, no. 2-3, pp. 121-129, Summer/Fall 1985.

Carlyle, Ralph E., "High Cost, Lack of Standards Is Slowing Pace of CASE," Datamation, pp. 23-24, August 15, 1987.

Chandler, John S., "A Multiple Criteria Approach for Evaluating Information Systems," MIS Quaterly, vol. 6, no. 1, pp. 61-74, March 1982.

Chervany, Norman L. and Gary W. Dickson, "Economic Evaluation of MIS: An Analytical Framework," Decision Science, vol. 1, no. 3, pp. 296-308, July 1970.

Christopher, William F., "How to Measure and Improve Productivity in Professional, Administrative, and Service Organizations," Productivity Management Handbook, vol. 3, no. 5, pp. 1-8, 1981.

Colton, Kent W., "Computer and Police: Patterns of Success and Failure," Sloan Management Review, vol. 14, no. 2, pp. 75-98, Winter 1972-73.

Cook, Rick, "How Do You Spell P-R-O-D-U-C-T-I-V-I-T-Y ?," Microage Quarterly, Summer 1988.

Craig, Charles E. and Clark R. Harris, "Total Productivity Measurement at the Firm Level," Sloan Management Review, vol. 14, no. 3, pp. 13-30, Spring 1973.

Cron, William L. and Marion G. Sobol, "The Relationship Between Computerization and Performance: A Strategy for Maximizing the Economic Benefits of Computerization," Information and Management, vol. 6, no. 3, pp. 171-181, June 1983.

Crummey, Steve, "Managing The Payoff," Speech presented at The Eqghead Forum (Sponsored by Lotus Development Corporation), Cambridge, Massachusetts, 1988.

Curley, Kathleen F. and Philip J. Pyburn, "Intellectual Technologies: The Key to Improving White-Collar Productivity," Sloan Management Review, vol. 24, no. 1, pp. 31-40, Fall 1982.

Decker, Jane E. and John P. Plumlee, "Microcomputers, Manpower and Performance in a Public Utility," Public Productivity Review, vol. 9, no. 2-3, pp. 213-225, Summer/Fall 1985.

Durand, Douglas E., Rex O. Bennet and Samuel Betty, "What Does Information Technology "Do" to Business Communications?: Two Empirical Studies," Information and Management, vol. 13, no. 3, pp. 111-117, October 1987.

Dyson, "Factory in Office..(Measure White Collar Productivity)," Forbes, January 25, 1988.

Edelman, Franz, "Managers, Computer Systems, and Productivity," MIS Quarterly, vol. 5, no. 3, pp. 1-19, September 1981.

Edstrom, Anders, "User Influence and the Success of MIS Project: A Contingency Approach," Human Relations, vol. 30, no. 7, pp. 589-607, 1977.

Englander, Valerie and Fred Englander, "Cost-Effectiveness of Computer-Based Welfare Fraid Detection in New Jersey," Public Productivity Review, vol. 9, no. 2-3, pp. 271-282, Summer/Fall 1988.

Epstein, Barry J. and William R. King, "An Experimental Study of the Value of Information," Omega, vol. 10, no. 3, pp. 249-258, 1982.

Felix, Glenn H. and James L. Riggs, "Productivity Measurement by Objective," National Productivity Review, pp. 386-392, Autumn 1983.

Flamholtz, Eric G., "Toward A Psycho-Technical System Paradigm of Organizational Measurement," Decision Science, vol. 10, no. 1, pp. 71-84, January 1979.

Franz, Charles R. and Daniel Robey, " Organizational Context, User Involvement, and The Usefulness of Information Systems," Decision Sciences, vol. 17, no. 3, pp. 329-355, Summer 1986.

Fuerst, William L. and Paul H. Cheney, "Concepts, Theory, and Techniques: Factors Affecting The Perceived Utilization of Computer-Based DSS in Oil Industry," Decision Sciences, vol. 13, pp. 554-569, 1982.

Gallagher, Charles A., "Perceptions of the Value of a Management Information System," Academy of Management Journal, vol. 17, no. 1, pp. 46-55, March 1974.

Gallupe, Brent R. and Gerardine DeSanctics, "Computer-Based Support for Group Problem Finding: An Experimental Investigation," MIS Quarterly, pp. 277-296, June 1988.

Ginzberg, Michael J., "Finding an Adequate Measure of OR/MS Effectiveness," Interfaces, vol. 8, no. 4, pp. 59-62, August 1978.

Goldfield, Randy J., "Achieving Greater White-Collar Productivity in the New Office," BYTE, pp. 154-172, May 1983.

Gosling, James J. and Lowell B. Jackson, "Getting the Most Out of Benefit-Cost Analysis: Application in the Wisconsin Department of Transportation," Government Finance Review, vol. 2, pp. 33-39, February 1986.

Grove, Andrew S., "Here's How the U.S. Can Increase Its Productivity," Unknown Newspaper, July, 29th 1980.

Hall P. G. and T. J. Lincoln, "A Cost Effectiveness Study of Production and Engineering System within a tightly integrated Manufacturing Environment," Management Datamatics, vol. 5, no. 6, pp. 262-274, 1976.

Hamilton, Scott and Norman L. Chervany, "Evaluating Information Effectiveness Part I: Comparing Evaluation Approach," MIS Quarterly, vol. 5, no. 3, pp. 55-69, September 1981.

Hamilton, Scott and Norman L. Chervany, "Evaluating Information Effectiveness Part II: Comparing Evaluator Viewpoints," MIS Quarterly, vol. 5, no. 4, pp. 79-86, December 1981.

Hamilton, Scott and Blake Ives, "MIS Research Strategies," Information and Management, vol. 5, no. 8, pp. 339-347, December 1982.

Hammer, Michael Dr., "Interview with editor: Senn, James A.," Society for Information Management, SPECTRUM, vol. 2, no. 6, December 1985.

Harvey, Jean, "Measuring Productivity in Professional Services," Public Productivity Review, no. 44, pp. 29-51, Winter 1987.

Hisrch, Paul M., "Organizational Effectiveness and the Institutional Environment," Administrative Science Quarterly, vol. 20, no. 3, pp. 327-344, September 1975.

Hogue, Jack T. and Hugh J. Watson, "An Examination of Decision-Makers' Utilization of Decision Support System Output," Information and Management, vol. 8, no. 4, pp. 205-212, August 1985.

Ives, Blake, M. H. Olson and Jack J. Baroudi, "The Measurement of User Information Sarisfaction," Communication of the ACM, vol. 26, no. 10, pp. 785-793, October 1983.

Kapsales, Peter, "Before and After WP: An Office Automation Productivity Study," Journal of Systems Management, pp. 7-9, April 1986.

Keen, Peter G. W., "Value Analysis: Justifying Decision Support System," MIS Quarterly, vol. 5, no. 1, pp. 1-15, March 1981.

King, William R. and Jaime I. Rodriguez, "Evaluating Management Information Systems," MIS Quarterly, pp. 43-51, September 1978.

King, William R. and Barry J. Epstein, "Assessing Information System Value: An Experimental Study," Decision Sciences, vol. 14, no. 1, pp. 34-45, January 1983.

King, John L. and Edward L. Schrems, "Cost-Benefit Analysis in Information System Development and Operation," Computing Surveys, vol. 10, no. 1, pp. 19-34, March 1978.

Kriebel, Charles A. and Arthur Raviv, "Application of Productivity Model for Computer Systems," Decision Sciences, vol. 13, no. 2 pp. 266-284, April 1982.

Lago, Armando M. and Diego R. Roque, "Inventory Cost Saving Benefits from the Standardization of Computer Modular Instruments," Omega, vol. 15, no. 4, pp. 331-337, January 1987.

LaPlante, Alice, "CEOs Question Value of Investments in Information Systems," Info World, March 5, 1988.

Larcker, David F. and Parker V. Lessig, "Perceived Usefulness of Information: A Psychometric Examination," Decision Sciences, vol. 11, pp. 121-134, 1980.

Leeke, Jim, "Measuring Productivity: Do Managers Benefit from PCs?," PC Week, pp. 78-90, April 4, 1988.

Lewin, Arie Y. and John W. Minton, "Determining Organizational Effectiveness Another Look, and An Agenda for Research," Management Science, vol. 32, no. 5, pp. 514-538, May 1986.

Lincoln, T., "Do Computer Systems Really Pay-off?," Information and Management, vol. 11, no. 1, pp. 25-34, August 1986.

Lotus Dev. Co., "Take the Lotus HAL Speedway to 1-2-3," Lotus Advertisement on Federal Computer Week, Pp. 9, July 25, 1988.

Lucas, Jr.,Henry C., Application and Implementation "Unsuccesfull Implementation: The Case of A Computer-Based Order Entry System," Decision Sciences, vol. 9, no. 1, pp. 68-79, January 1978.

Lucas, Jr. Henry C., "System Quality, User Reactions and The Use of Information Systems," Management Informatics, vol. 3, no. 4 pp. 207-212, 1974.

Lucas, Jr. Henry C., "Performance and The Use of an Information System," Management Sciences, vol. 21, no. 8, pp. 908-919, April 1975.

Lucas, Jr. Henry C., "The Use of Accounting Information System, Action and Organizational Performance," The Accounting Review, pp. 735-746, October 1975.

Mace, Scott, "Regis Merges Two Technologies (Hypermedia, Expert Systems More Effective Together Than Apart)," Info World, pp. 15-18, March 20, 1989.

Maggins, MS., "Gains of Automation," Computer World, November 3, 1986.

Maggiolini, Piercarlo, "Office Automation Benefits:A Framework," Information and Management, vol. 10, no. 2, pp. 75-81, January 1986.

Making Office Systems Pay Off, EDP Analyzer, vol. 23, no. 2, pp. 1-16, February 1985.

Mansour, Ali H. and Hugh J. Watson, "The Determinants of Computer Based Information System Performance," Academy of Management Journal, vol. 23, no. 3, pp. 521-533, September 1980.

Manzi, Jim, "Comdex Speech," COMDEX, Fall 1987.

Mark, Jerome A., "Measuring Productivity in Government (Federal, State, and Local)," Public Productivity Review, vol. 5, no. 1, pp. 21-44, March 1981.

Mason, Richard O., "Measuring Information Output: A Communication Systems Approach," Information and Management, vol. 1, no. 5, pp. 219-234, October 1978.

Mason, Alan, and Daniel Ryan, et.al., "Computer and Productivity," Public Productivity Revew, vol. 8, no. 1, pp. 70-84, Spring 1984.

Matlin, Gerald, "What Is The Value Of Investment In Information Systems?," MIS Quarterly, vol. 3, no. 3, pp. 5-34, September 1979.

McMillan, Charless J., "The Automation Triangle: New Paths to Productivity Performance," Business Quarterly, pp. 61-67, Fall 1987.

Melloan, Goerge, "Computers Elevate Product Quality Standards," The Wall Street Journal, pp. A21, October 11, 1988.

Miller, J. and B.A. Doyle, "Measuring the Effectiveness of Computer-Based Information System in the Financial Sector," MIS Quarterly, vol. 11, no. 1, pp. 107-124, March 1987.

Miller, Michael J., "Productivity Map Helps Managers to Set Goals, Measure Their Results," Info World, vol. 9, no. 29, pp. 43, July 20, 1987.

Money, Arthur, David Tromp and Trevor Wegner, "The Quantification of Decision Support Benefits Within the Context of Value Analysis," MIS Quarterly, pp. 223-236, June 1988.

Neumann, Seev and Eli Segev, "A Case Study of User Evaluation of Information Characteristics for Systems Improvement," Information and Maagement, vol. 2, pp. 271-278, 1979.

Nover, Carol, "Airco's new approach to white collar productivity," Modern Office Procedure, pp. 186-191, October 1980.

Olson, Margrethe H. and Henry C. Lucas Jr., "The Impact of Office Automation on the Organizatio: Some Implications for Reserach and Practice," Communication of the ACM, vol. 25, no. 11, pp. 838-847, November 1982.

Poppel, Harvey L., "Who Needs The Office Of The Future?," Harvard Business Review, vol. 54, no. 5, pp. 146-155, November-December 1982.

Pournelle, Jerry, "A User's View (Low Productivity, Inadequate Education Threaten U.S., Computer Industry)," Info World, pp. 57, October 19, 1987.

Raghunatan, TS and WR. King, "The Impact of Information Systems Planning on the Organization," Omega, vol. 16, no. 2, pp. 85-93, September 1987.

Reif, William E., Robert M. Monzka and John W. Newstrom, "Perception of the Formal and Informal Organizations: Objective Measurement Through the Semantic Differential Technique," Academy of Management Journal, vol. 16, no. 3, pp. 389-403, September 1983.

Richman, Tom, "Information Strategies: Paul Strassmann (American executives spend too much money on computer systems that allow them to do the wrong things faster)," INC, pp. 27-40, March 1988.

Ruby, Daniel and Richard L. Zeller, "Factors Affecting the Success and Failure of an Information System for Product Quality," Interfaces, vol. 8, no. 3, pp. 70-75, February 1978.

Ruby, Daniel, "User Attitudes and management Information System Use," Academy of Management Journal, vol. 22, no. 3, pp. 527-538, September 1979.

Ruby, Daniel, "PCs in Business: Do They Pay For Themselves," PC Week, vol. 3, no. 44, pp. 73-80, November 4, 1986.

Rockart, John F., "The Changing Role of the Information Systems Executive: A Critical Success Factors Perspective," Sloan Management Review, vol. 24, no. 1, pp. 3-14, Fall 1982.

Rockart, John F., "An Approach to Productivity In Two Knowledge-Based Industries," Sloan Management Review, vol. 15, no. 1, pp. 23-48, Fall 1973.

Rowe, David L., "How Westinghouse measure white collar productivity," Management Review, pp. 42-48, November 1981.

Schwartz Phd, Perry A., "Office Information Systems Cost Justification," CRA (Computer Research AssociateInc.), IEEE AES Magazine, pp. 21-26, August 1986.

Singleton, John P., Ephraim R. McLean and Edward N. Altman, "Measuring Information Systems Performance: Experience With the Management By Result at Security Pacific Bank," MIS Quarterly, vol. 12, no. 2, pp. 325-337, June 1988.

Smith, Peter and David Mayston, "Measuring Efficiency in the Public Sector," Omega, vol. 15, no. 2, pp. 181-189, 1987.

Snitkin, Sidney R. and William R. King, "Determinants of the Effectiveness of Personal Decision Support Systems," Information and Management, vol. 10, no. 2, pp. 83-89, January 1986.

Srinivasan, Ananth, "Alternative Measures of System Effectiveness: Associations and Implications," MIS Quarterly, vol. 9, no. 3, pp. 243-253, September 1985.

Staats, Elmer B., "Measuring and Enhancing Federal Productivity," Sloan Management Review, vol. 15, no. 1, pp. 1-10, Fall 1973.

Steers, Richard M., "Problem in the Measurement of Organizational Effectiveness," Administrative Science Quarterly, vol. 20, no. 4, pp. 546-558, December 1975.

Stix, Gary, "Justifying Costs: It Ain't Easy," DECISION Computer & Communications, pp. 74, September 1987.

Strassmann, Paul, "Information Payoff," Computer World, 1985.

Strassmann, Paul A., "Managing the Cost of Information," Harvard Business Review, vol. 54, no. 5, pp. 133-142, January-February 1976.

Strassmann, Paul A., "The Real Cost of OA," Datamation, vol. 31, no. 3, pp. 82-94, February 1985.

Sullivan, Robert S. and Stephen C. Secrest, "A Simple Optimization DSS for Production Planning at Dairyman's Cooperative Creamery Association," Interfaces, vol. 15, no. 5, pp. 46-53, September-October 1985.

Swanson, Burton E., "Management Information Systems: Appreciation and Involvement," Management Sciences, vol. 21, no. 2, pp. 178-188, October 1974.

Tarshis, Barry, "State of the Office (A Room with a view - BOSTI)," INC Office Guide, 1988.

Thor, Carl G., "White Collar Productivity Measurement," Productivity SA, pp. 3-11, July 1985.

Udler, Allan S. and Kay Monte-White, "Measuring Common Administrative Services (Assessing Productivity of Operating Personnel Offices)," A Productivity Measurement Publication, April 1980.

Worthley, John A., "Computer Technology and Productivity Improvement," Public Productivity Review, vol. 4, no. 1, pp. 10-20, March 1980.

Zarley, Craig, "The Crisis in Managing Corporate PC Assets," PC Week, April 26, 1988.

APPENDIX B

LIST OF SUBSET OF ARTICLES THAT REPORTED EMPIRICAL ARTICLES STUDIES

Aldag, Ramon J. and Daniel J. Power, "An Empirical Assessment of Computer Assisted Decision Analysis," Decision Sciences, vol. 17, no. 14, pp. 572-588, Fall 1986.

Altmeyer, Ann S and Lisle S. Bozeman, "Productivity via Computer Technology," Public Productivity Review, vol. 5, no. 4, December 1981.

Baily, James E., "Development of A Tool for Measuring and Analyzing Computer User Satisfaction," Management Sciences, vol. 29, no. 5, pp. 530-545, May 1983.

Ball, Leslie D., "Increasing the Manager's Productivity Through the Information System," Public Productivity Review, vol. 4, No. 1, pp. 51-62, March 1980.

Barkin, Stephen R. and Garry W. Dickson, "An Investigation of Information System Utilization," Information and Management, vol. 6, no. 1, pp. 35-45, December 1977.

Baroudi, Jack J. and Wanda J. Orlikowski, "A Short-Form Measure of User Information Satisfaction: A Psychometric Evaluation and Notes on Use," Journal of MIS, vol. 4, no. 4, pp. 44-59, Spring 1988.

Bruwer, P.J.S., "A Descriptive Model of Success for Computer-Based Information Systems," Information and Management, vol. 1, no. 2, pp. 63-67, July 1984.

Colton, Kent W., "Computer and Police: Patterns of Success and Failure," Sloan Management Review, vol. 14, no. 2, pp. 75-98, Winter 1972-73.

Cron, William L. and Marion G. Sobol, "The Relationship Between Computerization and Performance: A Strategy for Maximizing the Economic Benefits of Computerization," Information and Management, vol. 6, no. 3, pp. 171-181, June 1983.

Decker, Jane E. and John P. Plumlee, "Microcomputers, Manpower and Performance in a Public Utility," Public Productivity Review, vol. 9, no. 2-3, pp. 213-225, Summer/Fall 1985.

Durand, Douglas E., Rex O. Bennet, and Samuel Betty, "What Does Information Technology "Do" to Business Communications?: Two Empirical Studies," Information and Management, vol. 13, no. 3, pp. 111-117, October 1987.

Edelman, Franz, "Managers, Computer Systems, and Productivity," MIS Quarterly, vol. 5, no. 3, pp. 1-19, September 1981.

Edstrom, Anders, "User Influence and the Success of MIS Project: A Contingency Approach," Human Relations, vol. 30, no. 7, pp. 589-607, 1977.

Englander, Valerie and Fred Englander, "Cost-Effectiveness of Computer-Based Welfare Fraid Detection in New Jersey," Public Productivity Review, vol. 9, no. 2-3, pp. 271-282, Summer/Fall 1988.

Epstein, Barry J. and William R. King, "An Experimental Study of the Value of Information," Omega, vol. 10, no. 3, pp. 249-258, 1982.

Franz, Charles R. and Daniel Robey, " Organizational Context, User Involvement, and The Usefulness of Information Systems," Decision Sciences, vol. 17, no. 3, pp. 329-355, Summer 1986.

Fuerst, William L. and Paul H. Cheney, "Concepts, Theory, and Techniques: Factors Affecting The Perceived Utilization of Computer-Based DSS in Oil Industry," Decision Sciences, vol. 13, pp. 554-569, 1982.

Gallagher, Charles A., "Perceptions of the Value of a Management Information System," Academy of Management Journal, vol. 17, no. 1, pp. 46-55, March 1974.

Gallupe, Brent R. and Gerardine DeSanctics, "Computer-Based Support for Group Problem Finding: An Experimental Investigation," MIS Quarterly, pp. 277-296, June 1988.

Hall P. G. and T. J. Lincoln, "A Cost Effectiveness Study of Production and Engineering System within a tightly integrated Manufacturing Environment," Management Datamatics, vol. 5, no. 6, pp. 262-274, 1976.

Hogue, Jack T. and Hugh J. Watson, "An Examination of Decision-Makers' Utilization of Decision Support System Output," Information and Management, vol. 8, no. 4, pp. 205-212, August 1985.

Kapsales, Peter, "Before and After WP: An Office Automation Productivity Study," Journal of Systems Management, pp. 7-9, April 1986.

King, William R. and Barry J. Epstein, "Assessing Information System Value: An Experimental Study," Decision Sciences, vol. 14, no. 1, pp. 34-45, January 1983.

King, William R. and Jaime I. Rodriguez, "Evaluating Management Information Systems," MIS Quarterly, pp. 43-51, September 1978.

Larcker, David F. and Parker V. Lessig, "Perceived Usefulness of Information: A Psychometric Examination," Decision Sciences, vol. 11, pp. 121-134, 1980.

Lincoln, T., "Do Computer Systems Really Pay-off?," Information and Management, vol. 11, no. 1, pp. 25-34, August 1986.

Lucas, Jr. Henry C., "System Quality, User Reactions and The Use of Information Systems," Management Informatics, vol. 3, no. 4 pp. 207-212, 1974.

Lucas, Jr. Henry C., "Performance and The Use of an Information System," Management Sciences, vol. 21, no. 8, pp. 908-919, April 1975.

Lucas, Jr. Henry C., "The Use of Accounting Information System, Action and Organizational Performance," The Accounting Review, pp. 735-746, October 1975.

Lucas, Jr. Henry C., Application and Implementation "Unsuccesfull Implementation: The Case of A Computer-Based Order Entry System," Decision Sciences, vol. 9, no. 1, pp. 68-79, January 1978.

Mansour, Ali H. and Hugh J. Watson, "The Determinants of Computer Based Information System Performance," Academy of Management Journal, vol. 23, no. 3, pp. 521-533, September 1980.

Mason, Richard O., "Measuring Information Output: A Communication Systems Approach," Information and Management, vol. 1, no. 5, pp. 219-234, October 1978.

Matiln, Gerald, "What Is The Value Of Investment In Information Systems?," MIS Quarterly, vol. 3, no. 3, pp. 5-34, September 1979.

Miller, J. and B.A. Doyle, "Measuring the Effectiveness of Computer-Based Information System in the Financial Sector," MIS Quarterly, vol. 11, no. 1, pp. 107-124, March 1987.

Money, Arthur, David Tromp and Trevor Wegner, "The Quantification of Decision Support Benefits Within the Context of Value Analysis," MIS Quarterly, pp. 223-236, June 1988.

Neumann, Seev and Eli Segev, "A Case Study of User Evaluation of Information Characteristics for Systems Improvement," Information and Maagement, vol. 2, pp. 271-278, 1979.

Poppel, Harvey L., "Who Needs The Office Of The Future?," Harvard Business Review, vol. 54, no. 5, pp. 146-155, November-December 1982.

Raghunatan, TS and WR. King, "The Impact of Information Systems Planning on the Organization," Omega, vol. 16, no. 2, pp. 85-93, September 1987.

Rockart, John F., "The Changing Role of the Information Systems Executive: A Critical Success Factors Perspective," Sloan Management Review, vol. 24, no. 1, pp. 3-14, Fall 1982.

Ruby, Daniel and Richard L. Zeller, "Factors Affecting the Success and Failure of an Information System for Product Quality," Interfaces, vol. 8, no. 3, pp. 70-75, February 1978.

Ruby, Daniel, "User Attitudes and management Information System Use," Academy of Management Journal, vol. 22, no. 3, pp. 527-538, September 1979.

Snitkin, Sidney R. and William R. King, "Determinants of the Effectiveness of Personal Decision Support Systems," Information and Management, vol. 10, no. 2, pp. 83-89, January 1986.

Srinivasan, Ananth, "Alternative Measures of System Effectiveness: Associations and Implications," MIS Quarterly, vol. 9, no. 3, pp. 243-253, September 1985.

Sullivan, Robert S. and Stephen C. Secrest, "A Simple Optimization DSS for Production Planning at Dairyman's Cooperative Creamery Association," Interfaces, vol. 15, no. 5, pp. 46-53, September-October 1985.

Swanson, Burton E., "Management Information Systems: Appreciation and Involvement," Management Sciences, vol. 21, no. 2, pp. 178-188, October 1974.

APPENDIX C

NON-EMPIRICAL ARTICLES DEALING WITH MIS EFFECTIVENESS

Ahituv, Niv, "A Systematic Approach Toward Assessing The Value on Information System," MIS Quarterly, vol. 9, no. 4, pp. 65-75, December 1980.

Amirrezvani, Anita, "Plumbing the Corporate Pipeline," Data Base, pp. 174, August 1986.

Borko, Harold, "Information and Knowledge Worker Productivity," Information Processing Management, vol. 19, no. 4, pp. 203-212, 1983.

Calista, Donald J., "Microcomputer Applications to Productivity Improvements," Public Productivity Review, vol. 9, no. 2-3, pp. 121-129, Summer/Fall 1985.

Carlyle, Ralph E., "High Cost, Lack of Standards Is Slowing Pace of CASE," Datamation, pp. 23-24, August 15, 1987.

Chandler, John S., "A Multiple Criteria Approach for Evaluating Information Systems," MIS Quaterly, vol. 6, no. 1, pp. 61-74, March 1982.

Chervany, Norman L. and Gary W. Dickson, "Economic Evaluation of MIS: An Analytical Framework," Decision Science, vol. 1, no. 3, pp. 296-308, July 1970.

Curley, Kathleen F. and Philip J. Pyburn, "Intellectual Technologies: The Key to Improving White-Collar Productivity," Sloan Management Review, vol. 24, no. 1, pp. 31-40, Fall 1982.

Flamholtz, Eric G., "Toward A Psycho-Technical System Paradigm of Organizational Measurement," Decision Science, vol. 10, no. 1, pp. 71-84, January 1979.

Ginzberg, Michael J., "Finding an Adequate Measure of OR/MS Effectiveness," Interfaces, vol. 8, no. 4, pp. 59-62, August 1978.

Hamilton, Scott and Norman L. Chervany, "Evaluating Information Effectiveness Part I: Comparing Evaluation Approach," MIS Quarterly, vol. 5, no. 3, pp. 55-69, September 1981.

Hamilton, Scott and Norman L. Chervany, "Evaluating Information Effectiveness Part II: Comparing Evaluator Viewpoints," MIS Quarterly, vol. 5, no. 4, pp. 79-86, December 1981.

Hamilton, Scott and Blake Ives, "MIS Research Strategies," Information and Management, vol. 5, no. 8, pp. 339-347, December 1982.

Ives, Blake, M. H. Olson and, Jack J. Baroudi, "The Measurement of User Information Sarisfaction," Communication of the ACM, vol. 26, no. 10, pp. 785-793, October 1983.

Keen, Peter G. W., "Value Analysis: Justifying Decision Support System," MIS Quarterly, vol. 5, no. 1, pp. 1-15, March 1981.

King, John L. and Edward L. Schrems, "Cost-Benefit Analysis in Information System Development and Operation," Computing Surveys, vol. 10, no. 1, pp. 19-34, March 1978.

Maggiolini, Piercarlo, "Office Automation Benefits:A Framework," Information and Management, vol. 10, no. 2, pp. 75-81, January 1986.

Making Office Systems Pay Off, EDP Analyzer, vol. 23, no. 2, pp. 1-16, February 1985.

Mason, Alan, and Daniel Ryan, et.al., "Computer and Productivity," Public Productivity Revew, vol. 8, no. 1, pp. 70-84, Spring 1984.

Olson, Margrethe H. and Henry C. Lucas Jr., "The Impact of Office Automation on the Organizatio: Some Implications for Reserach and Practice," Communication of the ACM, vol. 25, no. 11, pp. 838-847, November 1982.

Strassmann, Paul A., "Managing the Cost of Information," Harvard Business Review, vol. 54, no. 5, pp. 133-142, January-February 1976.

Strassmann, Paul A., "The Real Cost of OA," Datamation, vol. 31, no. 3, pp. 82-94, February 1985.

APPENDIX D No. 1

REFERENCES TO POPULAR LITERATURE AND TRADE PRESS

Bowen, William, "The Puny Payoff From Office Computer," Fortune, pp. 20-24, May 26, 1986.

Cook, Rick, "How Do You Spell P-R-O-D-U-C-T-I-V-I-T-Y ?," Microage Quarterly, pp. 32-33, Summer 1988.

Crummey, Steve, "Managing The PC Payoff," Speech presented at The Egghead Forum (Sponsored by Lotus Development Corporation), Cambridege, Massachusetts, 1988.

Dyson, "Factory in Office..(Measure White Collar Productivity)," Forbes, January 25, 1988.

Grove, Andrew S., "Here's How the U.S. Can Increase Its Productivity," Unknown Newspaper, July 29, 1980.

Hammer, Michael Dr., "Interview with editor: Senn, James A.," Society for Information Management, SPECTRUM, vol. 2, no. 6, December 1985.

LaPlante, Alice, "CEOs Question Value of Investments in Information Systems," Info World, March 5, 1988.

Leeke, Jim, "Measuring Productivity: Do Managers Benefit form PCs?," PC Week, pp. 78-90, 1987.

Lotus Dev. Co., "Take the Lotus HAL speedway to 1-2-3," Lotus advertisement on Federal Computer Week, pp. 9, July 25, 1988.

Mace, Scott, "Regis Merges Two Technologies (Hypermedia, Expert Systems More Effective Together Than Apart)," Info World, pp. 15-18, March 20, 1989.

Maggins, MS., "Gains of Automation," Computer World, November 3, 1986.

Manzi, Jim, "Comdex Speech," COMDEX, Fall 1987.

Melloan, Goerge, "Computers Elevate Product Quality Standards," The Wall Street Journal, pp. A21, October 11, 1988.

Miller, Michael J., "Productivity Map Helps Managers to Set Goals, Measure Their Results," Info World, vol. 9, no. 29, pp. 43, July 20, 1987.

Pournelle, Jerry, "A User's View (Low Productivity, Inadequate Education Threaten U.S., Computer Industry)," Info World, pp. 57, October 19, 1987.

Richman, Tom, "Information Strategies: Paul Strassmann (American executives spend too much money on computer systems that allow them to do the wrong things faster)," INC, pp. 27-40, March 1980.

Ruby, Daniel, "PCs in Business: Do They Pay for Themselves?," PC Week, pp. 73-78, November 14, 1986.

Stix, Gary, "Justifying Costs: It Ain't Easy," DECISION Computer & Communications, pp. 74, September 1987.

Strassmann, Paul, "Information Payoff," Computer World, 1985.

Tarshis, Barry, "State of the Office (A Room with a view - BOSTI)," INC Office Guide, 1988.

Zarley, Craig, "The Crisis in Managing Corporate PC Assets," PC Week, April 26, 1988.

APPENDIX D No. 2

REFERENCES TO LITERATURE THAT DEAL WITH PRODUCTIVITY OR ORGANIZATIONAL EFFECTIVENESS IN GENERAL WITHOUT SPECIFIC APPLICATION TO MIS

Adler, Paul S., "A Plant Productivity Measure for "High-Tech" Manufacturing," Interfaces, vol. 17, no. 6, pp. 75-85, November-December 1987.

Anthony, Michael G., "IEs Measure Work, Write Standards For White Collar Workers At Financial Institution," /IE/, pp. 77-81, January 1984.

Bolte, Keith A., "Intel's War for White-Collar Productivity," National Productivity Review, pp. 46-53, Winter 1983-84.

Christopher, William F., "How to Measure and Improve Productivity in Professional, Administrative, and Service Organizations," Productivity Management Handbook (Productivity Yardstick), vol. 3, no. 5, pp. 1-8, 1981.

Craig, Charles E. and Clark, R. Harris, "Total Productivity Measurement at the Firm Level," Sloan Management Review, vol. 14, no. 3, pp. 13-30, Spring 1973.

Felix, Glenn H. and James L. Riggs, "Productivity Measurement by Objective," National Productivity Review, pp. 386-392, Autumn 1983.

Goldfield, Randy J., "Achieving Greater White-Collar Productivity in the New Office," BYTE, pp. 154-172, May 1983.

Gosling, James J. and Lowell B. Jackson, "Getting the Most Out of Benefit-Cost Analysis: Application in the Wisconsin Department of Transportation," Government Finance Review, vol. 2, pp. 33-39, February 1986.

Harvey, Jean, "Measuring Productivity in Professional Services," Public Productivity Review, no. 44, pp. 29-51, Winter 1987.

Hisrch, Paul M., "Organizational Effectiveness and the Institutional Environment," Administrative Science Quarterly, vol. 20, no. 3, pp. 327-344, September 1975.

Lewin, Arie Y. and John W. Minton, "Determining Organizational Effectiveness Another Look, and An Agenda for Research," Management Science, vol. 32, no. 5, pp. 514-538, May 1986.

Mark, Jerome A., "Measuring Productivity in Government (Federal, State, and Local)," Public Productivity Review, vol. 5, no. 1, pp. 21-44, March 1981.

McMillan, Charless J., "The Automation Triangle: New Paths to Productivity Performance," Business Quarterly, pp. 61-67, Fall 1987.

Nover, Carol, "Airco's new approach to white collar productivity," Modern Office Procedure, pp. 186-191, October 1980.

Rockart, John F., "An Approach to Productivity In Two Knowledge-Based Industries," Sloan Management Review, vol. 15, no. 1, pp. 23-48, Fall 1973.

Smith, Peter and David Mayston, "Measuring Efficiency in the Public Sector," Omega, vol. 15, no. 2, pp. 181-189, 1987.

Staats, Elmer B., "Measuring and Enhancing Federal Productivity," Sloan Management Review, vol. 15, no. 1, pp. 1-10, Fall 1973.

Steers, Richard M., "Problem in the Measurement of Organizational Effectiveness," Administrative Science Quarterly, vol. 20, no. 4, pp. 546-558, December 1975.

Thor, Carl G., "White Collar Productivity Measurement," Productivity SA, pp. 3-11, July 1985.

Udler, Allan S. and Kay Monte-White,"Measuring Common Administrative Services (Assessing Productivity of Operating Personnel Offices)," A Productivity Measurement Publication, April 1980.

APPENDIX D No. 3

REFERENCES TO LITERATURE OF RESEARCH METHODOLOGY WITHOUT SPECIFIC APPLICATION TO MIS

Baum, Bernard and Elmer Burack, "Information Technology, Manpower Development and Organizational Performance," Academy of Management Journal, pp. 279-291, September 1969.

Campbell, Donald T., "Factors Relevant to The Validity of Experiments in Social Settings," Psychological Bulletin, vol. 54, no. 4, pp. 297-312, 1977.

Campbell, John P., "On The nature of Organizational Effectiveness," New Perspectives on Organizations Effectiveness, Chapter 2, pp. 13-55., Jossey Press Pub. 1977.

Cook, Thomas D. and Donald T. Campbell, "The Design and Conduct of Quasi-Experiments and True Experiments in Field Setting," Handbook of Industrial and Organizational Psychology, Chapter 7, pp. 223-326., Rand McNally College Publishing Company, Chicago 1976.

Denzin, Norman K., "The Methodologies of Symbolic Interactionism: A Critical Review of Research Techniques," (perprint), 1968.

Feltham, Gerald A., "The Value of Information," The Accounting Review, pp. 684-696, October 1968.

Kriebel, Charles H. and Artur Raviv, "An Economics Approach to Modeling The Productivity of Computer System," Management Sciences, vol. 26, no. 3, pp. 297-311, March 1980.

Schiffer, Michael B. and James M. Skibo, " Theory and Experiment in The Study of Technological Change," Current Anthropology, vol. 28, no. 5, pp. 595-721, December 1987.

Stevens, S. S., "On The Theory of Scales of Measurement," Science, vol. 103, no. 2684, pp. 677-684, Friday, June 7, 1946.

Tanner, Daniel J., "User Ratings of Software Packages," Datamation, pp. 138-141, December 1975.

APPENDIX E

ANNOTATED DESCRIPTION OF EMPIRICAL STUDY

Aldag, Ramon J. and Daniel J. Power
An Empirical Assessment of Computer-Assisted Decision Analysis
Decision Sciences, vol.17, no.14, pp.572-588.
Fall 1988.

While some researchers have argued that computerized decision analysis programs may improve decision quality in such situations, research support for this assertion is weak.

While prior research shows that positive user affect apparently is a necessary condition for successful application of a computerized decision aid, this study demonstrates that user affect cannot be used as a proxy for quality. Report that a program is well liked or "seem useful" may say little or nothing about its actual value for improving decisions.

Altmeyer, Ann S. and Lisle S. Bozeman
Productivity via Computer Technology
Public Productivity Review, vol.5, no.4, pp.321-334.
December 1981.

What factors most affect the implementation of computerized management information systems in local social service departments? This approach takes into consideration environmental conditions such as pressure to implement the system as rapidly as possible, differing leadership styles, and variations in the size and capability of an organization.

What are the anticipated performance benefits from computerized management information systems? Performance benefits refer to productivity increases, improved internal managerial control of an agency, personal user attitudes and overall organization effectiveness.

Productivity is positively associated with the implementation of a computerized management information system; and overall effectiveness is positively associated with the implementation of a computerized management information system.

Baily, James E. and Sammy W. Pearson
Development of A Tool for Measuring and Analyzing Computer User Satisfaction
Management Sciences, vol.29, no.5, pp.530-545.
May 1983.

Productivity in computer services means both efficiently supplied and effectively utilized data processing outputs. It is argued that the utilization is directly connected to the user community's sense with those services.

The literature generally agreed that satisfaction in a given situation is the sum of one's feeling or attitudes toward a variety of factors affecting that situation.

The factors most frequently causing dissatisfaction were: 1. Time required for new developments. 2. Processing of change requests. 3. Flexibility. 4. Integration of the system. 5. Degree of training and 6. Top management involvement.

Additional validation efforts are needed in wide varieties of user environments. Factor analysis needs to be applied to see if and when the set of factors can be reduced. The instrument should be used to establish average levels of satisfaction in different situations. Closely controlled studies are needed to test the relationship between satisfaction and bottom line indicators of user and organization performance.

Ball, Leslie D.,
Increasing The manager's Productivity and Analyzing Computer User Satisfaction
Public Productivity Review, vol.4, no.1, pp.51-62.
March 1980.

No attempt was made to define management productivity. It seems probable that the software package employed in this study is a valuable management tool to increase information needed for the management decision-making process that will be used if it is made available to either private or public sector managers.

In many organizations there is a little communication between users and data processing. Based on this project, management perceived data processing as a system that would respond quickly to their needs with minimum effort on the part of the manager or his staff assistant.

Barkin, Stephen R. and Gary W. Dickson
An Investigation of Information System Utilization
Information and Management, vol.6, no.1, pp.35-45.
December 1977.

"(Use) of a system is one of the "key" variables associated with the success or desirability of the system".

The final task of communication effectiveness is whether the receiver uses the information he has obtained.

When the environment is complex, the relationship between cognitive style and data selection is operational, otherwise non-operational.

Baroudi, Jack J. and Wanda J. Orlikowski
A Short-Form Measure of User Information Satisfaction: A Psychometric Evaluation and Notes on Use
Journal of MIS, vol.4, no.4, pp.44-59.
Spring 1988.

A questionnaire's validity is the extent to which the questionnaire actually captures the concept it purports to measure.

The first role of the UIS measure is to detect the presence of a problem with user satisfaction in an organization. This would be achieved by administering a UIS survey and examining the total satisfaction scores. It is critical that the interpretation of UIS results be treated cautiously and contextually.

The UIS measure provides a way to obtain information about overall user satisfaction with information services as well as more focused information on specific satisfactions in the three areas of EDP staff and services, information product, and user knowledge and involvement.

The real value of a UIS measures lies in its ability to discriminate among a large number of possible problem areas. The situation and the purpose of the study should guide whether the manager/researcher choose the long form, the short form, or a simple one-question UIS measure.

Bruwer, P. J. S.,
A Descriptive Model of Success for Computer-Based Information Systems
Information and Management, vol.1, no.2, pp.63-67.
July 1984.

Post implementation evaluation of computer-based information systems is of vital importance for improving the operation of current systems and in the design of new applications.
Three major activities in which this plays an important part:

1. The acquisition of equipment.
2. In improving the operation of production systems.
3. In the design of new applications; this is extremely important, both to the computer staff and users of the system.

A cost-benefit study is one of the best ways to measure it. Obviously, the benefits from a computer-based system should exceed the cost of developing and running it. Unfortunately, assessing the benefits has been difficult, particularly for systems supporting sophisticated decisions; i.e., beyond the routine processing of transactions.

Cost-benefit is best but too difficult - so use user satisfaction. Use and satisfaction are relative, that is they are measure on a continuum, not a binary scale.

Colton, Kent W.
Computer and Police: Pattern of Success and Failure.
Sloan Management Review, vol.14, no.2, pp.75-98.
Winter 1972-73.

Inventory of problems, not a measure of success. No metric of effectiveness, only impressions.

There are indications that computer use may lead to centralization of power. Of those interviewed during the on site visits, 96% felt that computer use would lead to better information and grater control of the police department by those at the middle and top management level.

It should be remembered that the field of computer technology is still in its infancy. Perfection should not be expected instantly in an area so young and rapidly changing. On the other hand, there is a certain mystique, as well as commercial force, surrounding the application of computers. This has led to high expectations and in

some respects to oversell. As a consequence, there is a need for a continuing assessment of the benefits and impact of computer use.

Cron, William L. and Marion G. Sobol
The Relationship Between Computerization and Performance: A Strategy for Maximizing the Economic Benefits of Computerization
Information and Management, vol.6, no.3, pp.171-181. June 1983.

Surprisingly the immense growth in business usage of computer facilities and software in the past decade has not been accompanied by much analysis of the influence of computer ownership and compute usage on the sales, costs, and profitability of the firm. Part of the problem is one of cause and effect: whether higher computer usage leads to more profit or whether higher levels of profit lead to more computer usage. A second difficulty is that of estimating the sales or profits if computer systems had not been introduced.

They never discussed how performance should be measured or related to these variables.

Other attempts at evaluating performance of information systems have relied on management opinions, based on user surveys. Thus Neumann and Segev state "a universal measure like net effect on earning cannot be applied yet". In summary, the literature shows that relatively few studies of these effects have been made.

Result of this study indicate that computerization is positively related to the overall performance of medium and large size firms. Small firms should be cautious in estimating the potential for significant economies of scale from computerization, but should use information to facilitate management control and decision-making.

Decker, Jane E. and John P. Plumlee
Microcomputers, Manpower and Performance in a Public Utility
Public Productivity Review, vol.9, no.2-3, pp.213-225. Summer/Fall 1985.

Rarely, if ever, can managers simply deploy microcomputers into the organization and receive a clear-cut productivity bonus.

The Performance Improvement Division sought and acquired microcomputers not to create a system but to enhance its own productivity within that system.

The JEA experience demonstrates dramatically that the new technology of microcomputers provides real opportunity for the enhancement of public sector productivity.

Durand, Douglas E., Rex O. Bennet and Samuel Betty
What Does Information technology "Do" to Business Communications?: Two Empirical Studies
Information and Management, vol.13, no.3, pp.111-117.
October 1987.

Yet surprisingly little empirical research has been conducted to determine the effect of information technology on business communications.

Productivity can be divided into two segments: efficiency and effectiveness. Both studies suggest that end-user word processing communications result in different output than those produced by conventional means. Organizationally, productivity will decline unless the communication is more effective. Does the write's communication style effect the manager's confidence in decisions? Thus, important questions remain regarding the effectiveness of communications technology.

Edelman, Franz.
Managers, Computer System, and Productivity
MIS Quarterly, vol.5, no.3, pp.1-19.
September 1981.

One measure of system's effectiveness is the degree of its organizational impact.

The best load to more efficient office operations is through more effective support the managers.

Each dollar invested at the top of the pyramid in effective system technology can be expected to replace $X (X dollar) in white collar labor cost.

Edstrom, Anders.,
User Influence and the Success of MIS Projects: A Contingency Approach.
Human Relations, vol.30, no.7, pp.589-607.
1977.

There are several reasons why one has to resort perceptual data:

1. Generally one can estimate the cost for developing a system but not the benefits, mainly because a large number of these are intangible.
2. Managers do not seem to keep track of these data and hence they are not available for research purposes.
3. Even if we should know the complete cost-benefit picture, it still would be impossible to judge the relative success with respect to alternative solutions to the problem in any objective sense.

The information needs of the manager are thus crucial for the design of the system, and his satisfaction with the outcome is certainly a very important criterion of the success of the system.

The perceived success of an information system is, however, not only possible criterion of success and it seems to be useful to investigate alternative aspects of the success.

The phase of the development process is a further contingent factor and that it is important to distinguish between types of actors in the development process.

Englander, Valerie and Fred Englander
Cost-Effectiveness of Computer-Based Welfare Detection in New Jersey
Public Productivity Review, vol.9, no.2-3, pp.271-282.
Summer/Fall 1988.

The New Jersey program... entails a quarterly computer match of the social security numbers of welfare recipients... against the social security numbers of those on public and private payrolls.

Given that the fraud detection system was implemented simultaneously with major national welfare reform legislation, the New Jersey program was assessed by examining patterns in N.J. caseloads and average grant levels relative to the national trends. This methods generated an estimated savings of $45.6 million, substantially greater than the $6.2 million cost of operating the program. This is an encouraging result to those policy makers who have recently sought to extend

computer-based approaches to detect and prevent fraud in other Federal programs.

Epstein, Barry J. and William R. King
An Experimental Study of the Value of Information
Omega, vol.10, no.3, pp.249-258.
1982.

Virtually every controllable aspect of any information system, its design and implementation, are affected by how information is valued.
No satisfactory measure has been developed that has general applicability and the question of which measure should be applied in a given circumstance has not been adequately addressed.

Most measures of the value of information apply to a unit that is at a low level of aggregation. If this is the sort of information value concept that must be used in designing an IS, the designer is left either to design systems idiosyncratically for individual, or to aggregate information values across individual in order to construct a single measure that best reflects the organization's information values.

Franz, Charles R. and Daniel Ruby
Organizational Context, User Involvement, and The usefulness of Information Systems
Decision Sciences, vol.17, no.3, pp.329-355.
Summer 1986.

Two factors reflecting an MIS department's maturity (size and age) were found to reduce users' perceptions of system usefulness.

The role of organizational factors was more complex than first imagined. Failure of the second canonical correlation to produce significance led to the rejection of all our hypotheses about direct associations between organizational context and user involvement.

Suggested to strengthen the positive relationship between involvement during design and perceived usefulness. Paradoxically, MIS departments with broader scopes seemed to weaken this same relationship.

Fuerst, William L. and Paul H. Cheney
Concepts, Theory, and Techniques: Factors Affecting The Perceived Utilization of Computer-Based DSS in the Oil Industry
Decision Sciences, vol.13, pp.554-569
1982.

Perceived usage, for the purpose of this study, was defined as the decision makers' perception of how frequently they interacted with the DSS and how important the information obtained from the DSS was in assisting them to make decision.

In terms of general use, the factors of user training during the implementation process and the accuracy of output were found to be important.
The only factor of importance from the characteristics of the decision maker was the number of years of experience in the present position, and it was only important for specific DSS use. Thus the greater their years of experience in their position, the more managers will use the DSS for specific, personally initiated reports.

The important factors in the characteristics of the DSS are accuracy and relevancy of output.
Training and accuracy were found to be important in affecting general DSS use; and experience in the present position, user training, accuracy of output, and relevancy of output were important in affecting specific DSS use. Thus, the system's professional should stress those factors when designing, building, and implementing a DSS in order to maximize the degree to which decision makers use the system.

Gallagher, Charles A.,
Perceptions of the Value of a Management Information System.
Academy of Management Journal, vol.17, no.1, pp.46-55.
March 1974.

Difficulty measure benefits.A dollar comparison of costs with benefits cannot be made.

This study included one test of a new methodology. The result of a single test cannot establish the validity of a methodology. The study results suggest that the technique is basically useful in this application, nut better scales need to be found.

The finding of this study that managers in certain upper-level managerial positions valued EAB reports more highly

than other managers suggest the possibility of a general relationship between managerial position and the value of information. Such a general relationship, if it exists, should vary with the type of information and the type or organization structure.

Gallupe Brent R. and Gerardine DeSanctics
Computer-Based Support for Group Problem-Finding: An Experimental Investigation
MIS Quarterly, pp.277-296.
June 1988.

Two versions of the experimental task, one higher in difficulty and the other lower in difficulty, were administered to GDSS-supported and nonsupported decision-making group, yielding a 2 x 2 factorial design.

Groups with the higher difficulty task were less satisfied than those with the lower difficulty task; however, this difference was not significant. The anticipated interaction effect between GDSS support and task difficulty was not observed.

The only meaningful finding for this variable was that GDSS support resulted in a significantly lower level of satisfaction with the decision making process.

As controlled experimental study the findings cannot necessarily be generalized to all levels or types of GDSS software or to actual organizational use of GDSS technology.

Hall, P. G., and T. J. Lincoln
A Cost Effectiveness Study of Production and Engineering System within a tightly integrated Manufacturing Environment.
Management Datamatics, vol.5, no.6, pp.262-274.
1976.

SESAME was primarily established to evaluate the cost effectiveness of the computer systems at BAC-CAD. Any cost effectiveness study assumes a comparison of one situation with another. Although the most straightforward method of comparing costs and benefits would have been to compare the current computer systems with the cost of the number of people required to do the same job, it was felt that this would be a meaningless exercise.

These considerations suggest that the cost and benefits of the computer systems are best compared with the realistic manual systems that would probably be introduces if the computer was not available.

The basic philosophy of a SESAME study is that information for management is, in our ever more complex environment, rapidly becoming one of the most important of company resources and that good management demands the most effective utilization of the information resource that can be professionally obtained.

Hogue, Jack T. and Hugh J. Watson
An Examination of Decision-Makers' Utilization of Decision Support System Output
Information and Management, vol.8, no.4, pp.205-212.
August 1985.

Decisions are considered to include three major phases - intelligence, design, and choice. In order for a DSS to support the intelligent phase, it must provide information of a descriptive nature.

The primary justification for the development of a DSS is that it will be of value to the decision maker.

Monetary assessment of success is probably not likely since it is rare for a DSS user to formally evaluate the impact of the DSS on profits. It may be that the use of a DSS constitutes a successful system. This study has suggested some combination of satisfaction, acceptance, and frequency of use as potential indicators of success.

Kapsales, Peter
Before and After WP: An Office Automation Productivity Study
Journal of System Management, pp.7-9.
April 1986.

If I buy $70,000-worth of word processing (WP) equipment, my operators must still type the names and addresses. How much productivity is gained by word processing, when the number of key strokes is not reduced?

Managers must decide what the potential gain in productivity is, and if it is large enough to justify the cost of the new equipment. It is a difficult decision when there is not a reduction of keystrokes.

Is Word Processing Productive?
WP equipment is justified when it:

a. Saves the typist from making unnecessary keystrokes.
b. Speeds up and simplifies the document formatting activities.
c. Provides significant benefits by generating letters which are personally addressed to customers.

Automating an office almost always provides productivity improvements, but careful analysis should be performed to make sure the benefits outweigh the costs. The manual environment and the impact automation will have on it must be carefully evaluated.

King, William R. and Barry J. Epstein
Assessing Information Value: An Experimental Study
Decision Sciences, vol.14, no.1, pp.34-45.
January 1983.

Comparing opinions of total system with a linear model of opinions about separate attributes of system.
Big error: Calls a scale internal after explicitly directing respondents to treat it as ordinal.

This study demonstrates the practicality of using a multiattribute approach to the evaluation of information systems. These evaluations were compared with this calculated from a multiattribute linear value model. The two evaluations were found to be highly correlated.

The important notion of considering alternative system designs is often not operationally applied because of the complexity and cost involved in describing alternative systems that are directed toward the same managerial objective. The ease with which systems may be described in multiattribute terms suggests that the use of this approach may facilitate the explicit consideration of alternative designs.

King, William R. and Jaime I. Rodriguez
MIS Quarterly, pp.43-51.
September 1978.

Most evaluations of information systems are provided only in efficiency-oriented terms on a post hoc basis by system users.

Attitudes and value perceptions are an important and often neglected aspect of MIS evaluation.

The MIS evaluation process is thus a dynamic one in which each systematic evaluation effort can lead both to better information systems and to improved evaluation methodologies.

Larcker, David F. and Parker V. Lessig
Perceived Usefulness of Information: A Psychometric Examination
Decision Sciences, vol.11, pp.121-134.
1980.

Perceived importance will refer to the quality that causes a particular information set to acquire relevance to the decision maker. If the information items are a necessary input for tasks accomplishment, then this quality will tend to increase the perceived usefulness of the set.

Perceived usableness will refer to the information quality that allows a decision maker to utilize the set as an input for problem solution. If the information is clearly presented and readable or can be easily transformed, then this quality will tend to increase perceived usefulness.

A number of instruments have been employed to "measure" the perceived usefulness of information for decision making, but these techniques lack any data on the instrument reliability and validity. Thus in general sense, the previous techniques are inadequate and lead to a lack of comparability in research results.

Lincoln T.,
Do Computer Systems Really Pay-off?
Information and Management, vol.11, no.1, pp.25-34.
August 1986.

Despite the wide use of cost-benefit forecasting to justify proposed system investment, executives remain skeptical of the level of benefits actually achieved.

Such a situation reinforces suspicion in executive's minds that benefits from computer systems are speculative and probably marginal.

Post-audits of established systems, however do not have such an obvious basis for comparison and it is essential to decide what the comparitor will be before undertaking a study.

SESAME studies however are concerned with overall cost-effectiveness and it is usually possible for system boundaries to be defined which are meaningful to management and allow fairly straight-forward cost allocation. The objective is to produced a cost profile which is accepted by senior executives as realistic and comprehensive.

Increasingly we see a reluctance to invest further until concrete evidence is available that existing system investments have produced reasonable financial returns.

User benefits are frequently declared as "intangible" and rarely post-audited.
All too frequently there is a lack of financial discipline applied to the system development process: it is often unclear who is accountable for benefit achievement.

Lucas Jr., Henry C.,
System Quality, User Reactions and The Use of Information Systems.
Management Informatics, vol.3, no.4, pp.207-212.
1974.

The findings of this study suggest that before undertaking new systems, the quality of existing systems as rated by users should be satisfactory. It may be necessary to enhance or redesign existing systems before undertaking the development of new ones.

A user's past experience is his best predictor of the benefits of a new system, and successfully functioning systems are prerequisite to obtaining user cooperation in system design.

Though causality has not been demonstrated, a priory arguments and the data support the goals of developing favorable user attitudes and high quality systems to encourage the use of information systems.

Lucas Jr., Henry C.,
Performance and The Use of an Information System
Management Science, vol.21, no.8, pp.908-919.
April 1975.

Information can be used both to find and solve problems, though most current information systems seem to be oriented toward problem finding. Possibly problem finding data can be provided under exception conditions specified by users.

One of the most important implications of the model and results is that different personal, situational and decision style variables appear to affect the use of systems. These findings argue for more flexible systems to support different user' needs.

If attitudes are highly negative, on the other hand, users will minimize the contribution of the system and question the validity of output reports. Attitudes and perceptions of computer systems should be influenced in turn by the quality of the system as perceived by users.

Lucas Jr., Henry C.
Application and Implementation (Unsuccessful Implementation: The Case of A Computer-Based Order Entry System).
Decision Sciences, vol.21, no.8, pp.908-919.
April 1975.

Dependable variables have usually focused on some measure of the level of model or computer system usage. Where use is inappropriate, researchers have employed measures of satisfaction and/or favorable user attitudes as indicates of successful implementation.

Lucas Jr, Henry C.,
The Use of Accounting Information System, Action and Organizational Performance
The Accounting Review, pp.735-746.
October 1975

In a field study it is difficult to obtain good measures for operationalized variables and to control for confounding variables. The lack of extremely strong results can be partially attributed to errors in measuring the variables which were included in the research.

Laboratory experiments make it possible to control better for confounding variables, particularly in measuring performance. In addition to interviews and questionnaires, the use of protocols may be necessary to develop an understanding of how information is integrated with the decision-making process.

Mansour, Ali H. and Hugh J. Watson
The Determinants of Computer Based Information System Performance
Academy of Management Journal, vol.23, no.3, pp.521-533.
September 1980.

The effectiveness of the relationship between system personal and others in the organization have an impact on system performance. (They looked at from Behavioral Variable).

Mason, Richard O.,
Measuring Information Output: A Communication Systems Approach
Information and Management, vol.1, no.5, pp.219-234.
October 1978.

Notes, that measures of behavior require direct observation. The most frequently used measures of change in behavior are measures of ability to perform problem solving tasks and tests of skills, although most measures of change in behavior are unique to each situation and are difficult to identify in a complex situation.

Productivity may be measured as a ratio of useful output to the total number of executions of a unit operation. Our concerns for efficiency require that the output of these systems be related to the input resources consumed. Only then can managerial judgments be made as to the appropriateness of the allocations.

There is an important class of systems in our society, for which output measures are more difficult to define. These are systems whose primary output is information.

Matlin, Gerald.
What is The Value of Investment in Information System
MIS Quarterly, vol.3, no.3, pp.5-34.
September 1979.

Difficulty in finding a value is not an appropriate reason for avoiding the subject.

Are they getting what they paid for in MIS?

What is the value of the company's investment in Information Systems?

Managers intuitively know that the most of the benefits of IS investments are intangible, difficult to measure, and difficult to relate to profit result.

If the expenditure for the system investment is approved by appropriate levels of management and if other valuation methods are not appropriate to identify all benefits, then the value of the IS investment is equal to the standard of ROI in the company times the cost of the IS investment.

Miller, Jonathan and Brenda A. Doyle
Measuring the Effectiveness of Computer-Based Information System in the Financial Sector
MIS Quarterly, vol.11, no.1, pp.107-124.
March 1987.

It was found that performance varies widely between firms and that the better performers were those where the level of performance matched the perceived importance of the particular aspect of IS.

IS effectiveness here is, at least in part, a function of the relationship between perceived importance and performance on individual information systems attributes.

Money, Arthur., David Tromp and Trevor Wegner
The Quantification of Decision Support Benefits Within the Context of Value Analysis
MIS Quarterly, pp.223-236.
June 1988.

A DSS that is perceived to have value by the potential users is more likely to be adopted and implemented than one for which no significant value is perceived.

The technique used, namely conjoint measurement, is considered a robust procedure for converting subjective judgments about the relative importance of intangible benefits into numeric scores for further analysis.
Traditional cost-benefit approaches to evaluating the effectiveness of decision support systems are generally regarded as inadequate. More recent approaches account for the intangible benefit analysis, but still attempt to express benefits in terms of costs.

Consequently, a more rigorous interpretation of the perceived benefits of a DSS, which are a measure of value of the proposed DSS, should greatly facilitate the decision on whether to proceed with the next stage of development or acquisition.

Neumann, Seev and Eli Segev
A Case Study of User Evaluation of Information Characteristics for Systems Improvement
Information and Management, vol.2, pp.271-278.
1979.

The user of the information and his needs are the key for the system design. If the system does not fit the user's needs, it will not be used. Extent of use serves in this case as an indication of the success of the system.

Improvement of an existing system is aimed at providing a better response to user needs, that is, increasing the use of the system by increasing user satisfaction from existing system, it is necessary to first measure his current evaluation of the system, find out those aspects of the information which receive low evaluation, and then improve them.

The findings of this study indicate that the users at the bank had a holistic perception of their information, and that content was a dominant characteristic which spilled over other characteristics.

Poppel, Harvey L.
Who needs the office of the future?
Harvard Business Review, vol.54, no.5, pp.146-155.
November-December 1982.

Almost everyone could benefit from the new technology, according to this study of white-collar productivity.

Despite the allure, however, businesses are spending less than a nickel for such technology of every dollar of knowledge-worker salaries and internal support costs.

The fact is that most decision makers are skeptical about what managerial work stations, personal computers, video-conference rooms, and the other, newer icons of office automation can do for their businesses. These executives, disenchanted by their pervious exposure to ill-conceived forays into management information systems and word processing, doubt that knowledge workers will embrace the new technology, and they lack confidence that their organizations can channel and measure the intended benefits. In addition, members of the computer illiterate majority are worried about whether, when, and how they themselves will deal with these new electronic tools.

Raghunatan, TS. and W. R. King
The Impact of Information Systems Planning on the Organization
Omega, vol.16, no.2, pp.85-93.
September 1987.

"...Attempts to relate planning to overall business performance, measured in terms such as return-on-investment (ROI), are not fruitful, primarily because even such an important activity as strategic business planning is only one of many factors that influence ROI."
These studies, together with the limited ones done in an IS planning context, suggest that IS planning may be most fruitfully evaluated using a surrogate measure of its organizational impact and measures of the specific elements that make up the planning activity.

Rockart, John F.
The Changing Role of the Information Systems Executive: A Critical Success Factors Perspective
Sloan Management Review, vol.24, no.1, pp.3-14.
Fall 1982.

Three of the four critical success factors (communication, I/S human resources, and repositioning) directly reflect this evolving staff-oriented role definition. Operating responsibility for local I/S units is increasingly being transferred to local line managements. The top I/S executive today is a "thinker, planner, and coordinator" rather than a direct "implementor and doer."

Ruby, Daniel and Richard L. Zeller
Factors affecting the Success and Failure of an Information System for Product Quality
Interfaces, vol.8, no.3, pp.70-75.
February 1978.

As a research strategy, the comparative case study reported here strikes a balance between large sample survey techniques and one-shot case studies. It neither possesses the severe limitations of these forms of research nor makes full use of their advantages.
Our case indicates the importance of several factors in MIS implementation.

1. At the individual level, certain attitudes were found to be more important than others.
2. The organizational factors of complexity, formality, and centralization also affect implementation.
3. Lack of involvement by system developers is not sufficient to ensure failure if the vital function

of explaining the system to ultimate users assumed by some other knowledgeable person in the group.

4. Strong management support is instrumental to system adoption.

Ruby, Daniel.
User Attitudes and Management Information System Use
Academy of management Journal, vol.22, no.3, pp.527-538.
September 1979.

Overall, these results support the established notion that user attitudes (or perceptions) are significant correlates of system use. Attitudes are less powerful in predicting subjective assessments of perceived worth, although the relationships are significant. The finding that attitudes are more strongly related to actual use than they are to measures of perceived worth has important implications.

User concerns are critical to success of MIS, particularly concerns about the impact of MIS on individual performance. Obviously, these concerns should be addressed during implementation, but in some cases it may be too late by then.

A system that does not help people perform their jobs is not likely to be received favorably in spite of careful implementation efforts. A system that reduces rewards for users is likely to meet with disaster. A logical and often recommended approach to systems design is to involve users in the design effort. Systems designers and implementation teams would be well advised to find some means of addressing these concerns during MIS development.

Snitkin, Sidney R. and William R. King
Determinants of the Effectiveness of Personal Decision Support Systems
Information and Management, vol.10, no.2, pp.83-89.
January 1986.

The overall effectiveness of the system was assessed as is typical in such studies, using a perceptual measure. Overall, this study presents an interesting perspective on the evolving notion of a "personal DSS." The evidence that is analyzed here suggest that the pragmatic notion of personal DSSs has meaning and that some determinants of the effectiveness of such systems can be identified. While such systems do not meet the formal criteria for DSSs as they were initially conceived, they are important to the everyday functioning of business organizations, and as such.

Srinivasan, Ananth,.
Alternative Measures of System Effectiveness: Associations and Implications
MIS Quarterly, vol.9, no.3, pp.243-253.
September 1985.

While acknowledging the importance of economic analysis of MIS value, researchers responds to the shifting emphasis from efficiency to user effectiveness by focusing either on MIS usage or user perceived effectiveness.

From a practitioners perspective, it is important to understand what exactly is being measured when a system effectiveness study is initiated in an organization.

Sullivan, Robert S. and Stephen C. Secrest
A Simple Optimization DSS for Productivity Planning at Dairyman's Cooperative Creamery Association
Interfaces, vol.15, no.5, pp.46-53.
September-October 1985.

The milk flow analysis program, used for daily production planning and inventory forecasting, relieves plant supervisors of about four hours a day of overwhelming hand calculations.

In addition, the system has improved interaction between all levels of management.

The managers of milk processing plants in the United States rarely use computer-based production planning and decision support system.

The benefits from using MFAP are obvious but somewhat difficult to quantify (Then they aren't obvious). These benefits are the result of improved scheduling on the evaporator, the bottle-neck operation. MFAP has increased daily plant throughput by an estimated 150,000 pounds per day.

Swanson, Burton E.,
Management Information Systems: Appreciation and Involvement.
Management Sciences, vol.21, no.2, pp.178-188.
October 1974.

It seems reasonable to conclude that MIS appreciation coproduces (and is coproduced by) MIS involvement.

APPENDIX F

TABLES OF FINDINGS

Table F-1: Research Design Types

Study	Year	1 Pre Test	2 Comp Grp	3 Random Assign	Campbell & Stanley Design Type
1 Colton	1973				One shot case study
2 Lucas	1973		X		Static group comparison
3 Swanson	1974				One shot case study
4 Gallagher	1974				One shot case study
5 Lucas	1975				One shot case study
6 Lucas	1975				One shot case study
7 Hall & Lincoln	1976		X		Static group comparison
8 Barkin & Dickson	1977		X		Static group comparison
9 Edstrom	1977				One shot case study
10 King & Rodriguez	1978	X	X	X	True experiment
11 Robey & Zeller	1978			X	Static group comparison
12 Mason	1978				One shot case study
13 Lucas	1978	X	X	X	True experiment
14 Matlin	1979				One shot case study
15 Neumann & Segev	1979				One shot case study
16 Robey	1979				One shot case study
17 Mansour & Watson	1980				One shot case study
18 Ball	1980		X		One group pretest/posttest
19 Larcker & Lessig	1980				One shot case study
20 Edelman	1981			X	Static group comparison
21 Altmeyer & Bozeman	1981				One shot case study
22 Rockart	1982				One shot case study
23 Epstein & King	1982			X	Static group comparison
24 Feurst & Cheney	1982				One shot case study
25 Poppel	1982				One shot case study
26 Bailey & Pearson	1983				One shot case study
27 Cron & Sobol	1983				One shot case study
28 King & Epstein	1983				One shot case study
29 Bruwer	1984				One shot case study
30 Decker & Plumlee	1985				One shot case study
31 Englander & Englander	1985	X			Time series
32 Srinivasan	1985				One shot case study
33 Sullivan & Secrest	1985		X		One group pretest/posttest
34 Hogue & Watson	1985				One shot case study
35 Lincoln	1986			X	Static group comparison
36 Franz & Robey	1986				One shot case study
37 Kapsales	1986				One shot case study
38 Snitkin & King	1986				One shot case study
39 Aldag & Power	1986		X	X	Posttest only with control group
40 Miller & Doyle	1987				One shot case study
41 Durand et al	1987		X	X	Posttest only with control group
42 Raghunathan	1988				One shot case study
43 Baroudi & Orlikowski	1988				One shot case study
44 Money et al	1988				One shot case study
45 Gallupe et al	1988		X		Static group comparison

Table F-2: Threats to Internal Validity

STUDY	YEAR	His	Mat	Tst	Ins	Reg	Sel	Mor	Sel Mat
1 Colton	1973	-1	-1				-1	-1	
2 Lucas	1974	+1	?	+1	+1	-1	-1	-1	
3 Swanson	1974	-1	-1					-1	-1
4 Gallagher	1974	-1	-1					-1	-1
5 Lucas	1975	-1	-1					-1	-1
6 Lucas	1975	-1	-1					-1	-1
7 Hall & Lincoln	1976	+1	?	+1	+1	+1	-1	-1	-1
8 Barkin & Dickson	1977	+1	?	+1	+1	-1	-1	-1	
9 Edstrom	1977	-1	-1					-1	-1
10 King & Rodriguez	1978	+1	+1	+1	+1	+1	+1	+1	+1
11 Robey & Zeller	1978	+1	?	+1	+1	-1		-1	
12 Mason	1978	-1	-1					-1	-1
13 Lucas	1978	+1	+1	+1	+1	+1	+1	+1	
14 Matlin	1979	-1	-1					-1	-1
15 Neumann & Segev	1979	-1	-1					-1	-1
16 Robey	1979	-1	-1					-1	-1
17 Mansour & Watson	1980	-1	-1					-1	-1
18 Ball	1980	-1	-1	-1	-1	?	+1	+1	-1
19 Larcker & Lessig	1980	-1	-1					-1	-1
20 Edelman	1981	+1	?	+1	+1	+1	-1	-1	-1
21 Altmeyer & Bozeman	1981	-1	-1					-1	-1
22 Rockart	1982	-1	-1					-1	-1
23 Epstein & King	1982	+1	?	+1	+1	+1	-1	-1	-1
24 Feurst & Cheney	1982	-1	-1					-1	-1
25 Poppel	1982	-1	-1					-1	-1
26 Bailey & Pearson	1983	-1	-1					-1	-1
27 Cron & Sobol	1983	-1	-1					-1	-1
28 King & Epstein	1983	-1	-1					-1	-1
29 Bruwer	1984	-1	-1					-1	-1
30 Decker & Plumlee	1985	-1	-1					-1	-1
31 Englander & Englander	1985	-1	+1	+1	?	+1	+1	+1	+1
32 Srinivasan	1985	-1	-1					-1	-1
33 Sullivan & Secrest	1985	-1	-1	-1	-1	?	+1	+1	-1
34 Hogue & Watson	1985	-1	-1					-1	-1
35 Lincoln	1986	+1	?	+1	+1	+1	-1	-1	-1
36 Franz & Robey	1986	-1	-1					-1	-1
37 Kapsales	1986	-1	-1					-1	-1
38 Snitkin & King	1986	-1	-1					-1	-1
39 Aldag & Power	1986	+1	+1	+1	+1	+1	+1	+1	+1
40 Miller & Doyle	1987	-1	-1					-1	-1
41 Durand et al	1987	+1	+1	+1	+1	+1	+1	+1	+1
42 Raghunathan	1988	-1	-1					-1	-1
43 Baroudi & Orlikowski	1988	-1	-1					-1	-1
44 Money et al	1988	-1	-1					-1	-1
45 Gallupe et al	1988	+1	?	+1	+1	+1	-1	-1	-1

Table F-3: Threats to External Validity

Study	Year	Interactions: Test & X	Interactions: Selct & X	Reactv Arrg	Multiple X Interf
1 Colton	1973		-1		
2 Lucas	1974		-1		
3 Swanson	1974		-1		
4 Gallagher	1974		-1		
5 Lucas	1975		-1		
6 Lucas	1975		-1		
7 Hall & Lincoln	1976		-1		
8 Barkin & Dickson	1977		-1		
9 Edstrom	1977		-1		
10 King & Rodriguez	1978	-1	?	?	
11 Robey & Zeller	1978		-1		
12 Mason	1978		-1		
13 Lucas	1978	-1	?	?	
14 Matlin	1979		-1		
15 Neumann & Segev	1979		-1		
16 Robey	1979		-1		
17 Mansour & Watson	1980		-1		
18 Ball	1980	-1	-1	?	
19 Larcker & Lessig	1980		-1		
20 Edelman	1981		-1		
21 Altmeyer & Bozeman	1981		-1		
22 Rockart	1982		-1		
23 Epstein & King	1982		-1		
24 Feurst & Cheney	1982		-1		
25 Poppel	1982		-1		
26 Bailey & Pearson	1983		-1		
27 Cron & Sobol	1983		-1		
28 King & Epstein	1983		-1		
29 Bruwer	1984		-1		
30 Decker & Plumlee	1985		-1		
31 Englander & Englander	1985	-1	?	?	
32 Srinivasan	1985		-1		
33 Sullivan & Secrest	1985	-1	-1	?	
34 Hogue & Watson	1985		-1		
35 Lincoln	1986		-1		
36 Franz & Robey	1986		-1		
37 Kapsales	1986		-1		
38 Snitkin & King	1986		-1		
39 Aldag & Power	1986	+1	?	?	
40 Miller & Doyle	1987		-1		
41 Durand et al	1987	+1	?	?	
42 Raghunathan	1988		-1		
43 Baroudi & Orlikowski	1988		-1		
44 Money et al	1988		-1		
45 Gallupe et al	1988		-1		

Table F-4: Handling of Time Dimension

STUDY	YEAR	Handled Time Dimension:
1 Colton	1973	No
2 Lucas	1974	No
3 Swanson	1974	No
4 Gallagher	1974	No
5 Lucas	1975	No
6 Lucas	1975	No
7 Hall & Lincoln	1976	No
8 Barkin & Dickson	1977	No
9 Edstrom	1977	No
10 King & Rodriguez	1978	Yes
11 Robey & Zeller	1978	No
12 Mason	1978	No
13 Lucas	1978	Yes
14 Matlin	1979	No
15 Neumann & Segev	1979	No
16 Robey	1979	No
17 Mansour & Watson	1980	No
18 Ball	1980	Yes
19 Larcker & Lessig	1980	No
20 Edelman	1981	No
21 Altmeyer & Bozeman	1981	No
22 Rockart	1982	No
23 Epstein & King	1982	No
24 Feurst & Cheney	1982	No
25 Poppel	1982	No
26 Bailey & Pearson	1983	No
27 Cron & Sobol	1983	No
28 King & Epstein	1983	No
29 Bruwer	1984	No
30 Decker & Plumlee	1985	No
31 Englander & Englander	1985	Yes
32 Srinivasan	1985	No
33 Sullivan & Secrest	1985	Yes
34 Hogue & Watson	1985	No
35 Lincoln	1986	No
36 Franz & Robey	1986	No
37 Kapsales	1986	No
38 Snitkin & King	1986	No
39 Aldag & Power	1986	No
40 Miller & Doyle	1987	No
41 Durand et al	1987	No
42 Raghunathan	1988	No
43 Baroudi & Orlikowski	1988	No
44 Money et al	1988	No
45 Gallupe et al	1988	No

Table F-5: Data Collection Techniques

Study	Year	1st Method Used	2nd Method Used
1 Colton	1973	Mailed Questionnaire	Interview Survey
2 Lucas	1974	Questionnaire	
3 Swanson	1974	Archival	Questionnaire
4 Gallagher	1974	Questionnaire	Smantic Differential
5 Lucas	1975	Questionnaire	
6 Lucas	1975	Mailed Questionnaire	Archival
7 Hall & Lincoln	1976	Interview Survey	
8 Barkin & Dickson	1977	Questionnaire	Simulation
9 Edstrom	1977	Interview Survey	
10 King & Rodriguez	1978	Questionnaire	
11 Robey & Zeller	1978	Questionnaire	
12 Mason	1978	Questionnaire?	
13 Lucas	1978	Mailed Questionnaire	Questionnaire
14 Matlin	1979	Archival	
15 Neumann & Segev	1979	Questionnaire	
16 Robey	1979	Archival	Mailed Questionnaire
17 Mansour & Watson	1980	Mailed Questionnaire	
18 Ball	1980	Questionnaire	Archival
19 Larcker & Lessig	1980	Questionnaire	
20 Edelman	1981	Archival	
21 Altmeyer & Bozeman	1981	Phone Interview	Mailed Questionnaire
22 Rockart	1982	Interview Survey	
23 Epstein & King	1982	Questionnaire	
24 Feurst & Cheney	1982	Mailed Questionnaire	Mailed Questionnaire
25 Poppel	1982	Diary	Questionnaire
26 Bailey & Pearson	1983	Interview Survey	Mailed Questionnaire
27 Cron & Sobol	1983	Questionnaire	
28 King & Epstein	1983	Questionnaire	
29 Bruwer	1984	Questionnaire	
30 Decker & Plumlee	1985	Archival	
31 Englander & Englander	1985	Archival	
32 Srinivasan	1985	Mailed Questionnaire	
33 Sullivan & Secrest	1985	Archival	
34 Hogue & Watson	1985	Interview Survey	Questionnaire
35 Lincoln	1986	Questionnaire	
36 Franz & Robey	1986	Questionnaire	
37 Kapsales	1986	Archival	
38 Snitkin & King	1986	Mailed Questionnaire	
39 Aldag & Power	1986	Laboratory Experiment	Questionnaire
40 Miller & Doyle	1987	Mailed Questionnaire	
41 Durand et al	1987	Laboratory Experiment	
42 Raghunathan	1988	Mailed Questionnaire	
43 Baroudi & Orlikowski	1988	Mailed Questionnaire	
44 Money et al	1988	Questionnaire	
45 Gallupe et al	1988	Panel	Questionnaire

Table F-6: Definitions of Effectiveness

Study	Year	Definition of System Payoff
1 Colton	1973	System usage
2 Lucas	1974	Attitude of users toward system
3 Swanson	1974	System usage
4 Gallagher	1974	Dollar value information
5 Lucas	1975	System usage
6 Lucas	1975	System usage
7 Hall & Lincoln	1976	Cost savings
8 Barkin & Dickson	1977	Information usage
9 Edstrom	1977	User influence
10 King & Rodriguez	1978	Attitude of users toward system
11 Robey & Zeller	1978	Attitude of users toward system
12 Mason	1978	Problem solving ability
13 Lucas	1978	System usage
14 Matlin	1979	Value/cost ratio
15 Neumann & Segev	1979	Attitude of users toward system
16 Robey	1979	System value
17 Mansour & Watson	1980	Performance factors
18 Ball	1980	Attitude of users toward system
19 Larcker & Lessig	1980	Information usefulness
20 Edelman	1981	Cost avoidance
21 Altmeyer & Bozeman	1981	Attitude of users toward system
22 Rockart	1982	Job factors
23 Epstein & King	1982	Attitude of users toward system
24 Feurst & Cheney	1982	System usage
25 Poppel	1982	Office automation
26 Bailey & Pearson	1983	Attitude of users toward system
27 Cron & Sobol	1983	Return on investment
28 King & Epstein	1983	Information value
29 Bruwer	1984	Attitude of users toward system
30 Decker & Plumlee	1985	Not clear
31 Englander & Englander	1985	Cost savings
32 Srinivasan	1985	Attitude of users toward system
33 Sullivan & Secrest	1985	Profit
34 Hogue & Watson	1985	System usage
35 Lincoln	1986	Cost benefit
36 Franz & Robey	1986	System usefulness
37 Kapsales	1986	Cost avoidance
38 Snitkin & King	1986	Attitude of users toward system
39 Aldag & Power	1986	Decision quality
40 Miller & Doyle	1987	Attitude of users toward system
41 Durand et al	1987	Grammar
42 Raghunathan	1988	Implementation of plan
43 Baroudi & Orlikowski	1988	Attitude of users toward system
44 Money et al	1988	Attitude of users toward system
45 Gallupe et al	1988	Decision quality

Table F-7: Reports of Change in System Effectiveness

Study	Year	Reported Change
1 Colton	1973	Not reported
2 Lucas	1974	Not reported
3 Swanson	1974	Not reported
4 Gallagher	1974	Not reported
5 Lucas	1975	Not reported
6 Lucas	1975	Not reported
7 Hall & Lincoln	1976	25%
8 Barkin & Dickson	1977	Not reported
9 Edstrom	1977	Not reported
10 King & Rodriguez	1978	Not reported
11 Robey & Zeller	1978	Not reported
12 Mason	1978	?
13 Lucas	1978	Not reported
14 Matlin	1979	1.1 to 3.3
15 Neumann & Segev	1979	Not reported
16 Robey	1979	Not reported
17 Mansour & Watson	1980	Not reported
18 Ball	1980	Not reported
19 Larcker & Lessig	1980	Not reported
20 Edelman	1981	15 to 20%
21 Altmeyer & Bozeman	1981	Not reported
22 Rockart	1982	Not reported
23 Epstein & King	1982	Not reported
24 Feurst & Cheney	1982	Not reported
25 Poppel	1982	Not reported
26 Bailey & Pearson	1983	Not reported
27 Cron & Sobol	1983	?
28 King & Epstein	1983	Not reported
29 Bruwer	1984	Not reported
30 Decker & Plumlee	1985	?
31 Englander & Englander	1985	49%
32 Srinivasan	1985	Not reported
33 Sullivan & Secrest	1985	$100,000
34 Hogue & Watson	1985	Not reported
35 Lincoln	1986	13-400%
36 Franz & Robey	1986	Not reported
37 Kapsales	1986	102%
38 Snitkin & King	1986	Not reported
39 Aldag & Power	1986	No improvement following implementation
40 Miller & Doyle	1987	Not reported
41 Durand et al	1987	Not reported
42 Raghunathan	1988	Not reported
43 Baroudi & Orlikowski	1988	Not applicable
44 Money et al	1988	Not reported
45 Gallupe et al	1988	Group decision support system supported better quality of decisions

LIST OF REFERENCES

Adler, Paul S., "A Plant Productivity Measure for "High-Tech" Manufacturing," Interfaces, vol. 17, no. 6, pp. 75-85, November-December 1987.

Ahituv, Niv, "A Systematic Approach Toward Assessing The Value on Information System," MIS Quarterly, vol. 9, no. 4, pp. 65-75, December 1980.

Aldag, Ramon J. and Daniel J. Power, "An Empirical Assessment of Computer Assisted Decision Analysis," Decision Sciences, vol. 17, no. 14, pp. 572-588, Fall 1986.

Altmeyer, Ann S and Lisle S. Bozeman, "Productivity via Computer Technology," Public Productivity Review, vol. 5, no. 4, December 1981.

Amirrezvani, Anita, "Plumbing the Corporate Pipeline," Data Base, pp. 174, August 1986.

Anthony, Michael G., "IEs Measure Work, Write Standards For White Collar Workers At Financial Institution," /IE/, pp. 77-81, January 1984.

Baily, James E., "Development of A Tool for Measuring and Analyzing Computer User Satisfaction," Management Sciences, vol. 29, no. 5, pp. 530-545, May 1983.

Ball, Leslie D., "Increasing the Manager's Productivity Through the Information System," Public Productivity Review, vol. 4, No. 1, pp. 51-62, March 1980.

Barkin, Stephen R. and Garry W. Dickson, "An Investigation of Information System Utilization," Information and Management, vol. 6, no. 1, pp. 35-45, December 1977.

Baroudi, Jack J. and Wanda J. Orlikowski, "A Short-Form Measure of User Information Satisfaction: A Psychometric Evaluation and Notes on Use," Journal of MIS, vol. 4, no. 4, pp. 44-59, Spring 1988.

Baroudi, Jack J., Margrethe H. Olson and Blake Ives, "An Empirical Study of the Impact of User Involvement on System Usage and Information Satisfaction," Communication of the ACM, vol. 29, no. 3, pp. 232-238, March 1986.

Baum, Bernard and Elmer Burack, "Information Technology, Manpower Development and Organizational Performance," Academy of Management Journal, pp. 279-291, September 1969.

Boland, Richard J., Jr., "Phenomenology: A Preferred Approach to Research on Information System," in Enid Mumford, et.al (editions) Research Methods in Information Systems, pp. 193-201, Amsterdam: North Holland, 1985.

Bolte, Keith A., "Intel's War for White-Collar Productivity," National Productivity Review, pp. 46-53, Winter 1983-84.

Borko, Harold, "Information and Knowledge Worker Productivity," Information Processing Management, vol. 19, no. 4, pp. 203-212, 1983.

Bowen, William, "The Puny Payoff From Office Computers," FORTUNE, Pp. 20-24, May 26, 1986.

Brancheau, James C. and James C. Wetherbe, "1986 Key Information Systems Management Issues," MIS Research Center, Carlson School of Management, University of Minnesota, Minneapolis, MN 55455, November 1986.

Brewin, Bob, "Tobin Examines Navy Microcomputer at Show," Federal Computer Week, pp. 4, May 29, 1989.

Bruwer, P.J.S., "A Descriptive Model of Success for Computer-Based Information Systems," Information and Management, vol. 1, no. 2, pp. 63-67, July 1984.

Bulkeley, William M., "Uncovering The Hidden Costs," The Wall Street Journal, (Technology Managers' Guide), pp. 14D, Friday, June 12, 1987.

Buller, Paul F. and Cecil H. Bell Jr., "Effects of Team Building and Goal Setting on Productivity: A Field Experiment," Academy of Management Journal, vol. 29, no. 2, pp. 305-328, June 1986.

Buss, Martin D. J., "Pennywise Apporach to Data Processing," Harvard Business Review, vol. 59, no. 4, pp. 111-117, July-August 1981.

Calista, Donald J., "Microcomputer Applications to Productivity Improvements," Public Productivity Review, vol. 9, no. 2-3, pp. 121-129, Summer/Fall 1985.

Campbell, John P., "On The nature of Organizational Effectiveness," New Perspectives on Organizations Effectiveness, Chapter 2, pp. 13-55., Jossey Press Pub. 1977.

Campbell, Donald T., "Factors Relevant to The Validity of Experiments in Social Settings," Psychological Bulletin, vol. 54, no. 4, pp. 297-312, 1977.

Campbell, Donald T. and Julian C. Stanley, "Experimental and Quasi-Experimental Designs For Research," Rand McNally & Company, Chicago, 1966.

Carlyle, Ralph E., "High Cost, Lack of Standards Is Slowing Pace of CASE," Datamation, pp. 23-24, August 15, 1987.

Chandler, John S., "A Multiple Criteria Approach for Evaluating Information Systems," MIS Quaterly, vol. 6, no. 1, pp. 61-74, March 1982.

Chervany, Norman L. and Gary W. Dickson, "Economic Evaluation of MIS: An Analytical Framework," Decision Science, vol. 1, no. 3, pp. 296-308, July 1970.

Christopher, William F., "How to Measure and Improve Productivity in Professional, Administrative, and Service Organizations," Productivity Management Handbook (Productivity Yardstick), vol. 3, no. 5, pp. 1-8, 1981.

Coleman, James S., The Methods of Sociology, In Robert Bierstaedt (ed.), "A Design for Sociology: Scope, Objectives, and Methods," pp. 86-114. Philadelphia: American Academy of Political and Social Science, 1969.

Coleman, James S., "Relational Analysis: The Study of Social Organization with Survey Methods," Human Organization no. 17, pp. 28-36, Spring 1958.

Colton, Kent W., "Computer and Police: Patterns of Success and Failure," Sloan Management Review, vol. 14, no. 2, pp. 75-98, Winter 1972-73.

Cook, Thomas D. and Donald T. Campbell, "The Design and Conduct of Quasi-Experiments and True Experiments in Field Setting," Handbook of Industrial and Organizational Psychology, Chapter 7, pp. 223-326., Rand McNally College Publishing Company, Chicago 1976.

Cook, Rick, "How Do You Spell P-R-O-D-U-C-T-I-V-I-T-Y ?," Microage Quarterly, Summer 1988.

Craig, Charles E. and Clark R. Harris, "Total Productivity Measurement at the Firm Level," Sloan Management Review, vol. 14, no. 3, pp. 13-30, Spring 1973.

Cron, William L. and Marion G. Sobol, "The Relationship Between Computerization and Performance: A Strategy for Maximizing the Economic Benefits of Computerization," Information and Management, vol. 6, no. 3, pp. 171-181, June 1983.

Crummey, Steve, "Managing The Payoff," Speech presented at The Egghead Forum (Sponsored by Lotus Development Corporation), Cambridge, Massachusetts, 1988.

Curley, Kathleen F. and Philip J. Pyburn, "Intellectual Technologies: The Key to Improving White-Collar Productivity," Sloan Management Review, vol. 24, no. 1, pp. 31-40, Fall 1982.

Davis, Gordon, "A Systematic Evaluation of The Publications for Promotion of MIS Academics," Proceeding of ICIS Conference on IS, pp. 206-216, Philadelphia, December 1980.

Decker, Jane E. and John P. Plumlee, "Microcomputers, Manpower and Performance in a Public Utility," Public Productivity Review, vol. 9, no. 2-3, pp. 213-225, Summer/Fall 1985.

Denzin, Norman K., "The Research Act" (A Theoretical Introduction to Sociological Methods), Aldine Publishing Company, Chicago, Fourth Printing 1973.

Denzin, Norman K., "The Methodologies of Symbolic Interactionism: A Critical Review of Research Techniques," (perprint), 1968.

Durand, Douglas E., Rex O. Bennet and Samuel Betty, "What Does Information Technology "Do" to Business Communications?: Two Empirical Studies," Information and Management, vol. 13, no. 3, pp. 111-117, October 1987.

Dyson, "Factory in Office..(Measure White Collar Productivity)," Forbes, January 25, 1988.

Edelman, Franz, "Managers, Computer Systems, and Productivity," MIS Quarterly, vol. 5, no. 3, pp. 1-19, September 1981.

Edstrom, Anders, "User Influence and the Success of MIS Project: A Contingency Approach," Human Relations, vol. 30, no. 7, pp. 589-607, 1977.

Englander, Valerie and Fred Englander, "Cost-Effectiveness of Computer-Based Welfare Fraid Detection in New Jersey," Public Productivity Review, vol. 9, no. 2-3, pp. 271-282, Summer/Fall 1988.

Epstein, Barry J. and William R. King, "An Experimental Study of the Value of Information," Omega, vol. 10, no. 3, pp. 249-258, 1982.

Fawcette, James E., "..if people like using a computer more it follows they'll be more productive.," Business Software, vol. 6, no. 9, pp. 42, August 1988.

Felix, Glenn H. and James L. Riggs, "Productivity Measurement by Objective," National Productivity Review, pp. 386-392, Autumn 1983.

Feltham, Gerald A., "The Value of Information," The Accounting Review, pp. 684-696, October 1968.

Flamholtz, Eric G., "Toward A Psycho-Technical System Paradigm of Organizational Measurement," Decision Science, vol. 10, no. 1, pp. 71-84, January 1979.

Franz, Charles R. and Daniel Robey, " Organizational Context, User Involvement, and The Usefulness of Information Systems," Decision Sciences, vol. 17, no. 3, pp. 329-355, Summer 1986.

Fuerst, William L. and Paul H. Cheney, "Concepts, Theory, and Techniques: Factors Affecting The Perceived Utilization of Computer-Based DSS in Oil Industry," Decision Sciences, vol. 13, pp. 554-569, 1982.

Gallagher, Charles A., "Perceptions of the Value of a Management Information System," Academy of Management Journal, vol. 17, no. 1, pp. 46-55, March 1974.

Gallegos, Lynn, Richard Welke and James Wetherbe, "Foreword," Proceedings of the Sixth International Conference on Information Systems, pp. V, Indianapolis, Indiana, December 16-18, 1985.

Gallupe, Brent R. and Gerardine DeSanctics, "Computer-Based Support for Group Problem Finding: An Experimental Investigation," MIS Quarterly, pp. 277-296, June 1988.

Ginzberg, Michael J., "Finding an Adequate Measure of OR/MS Effectiveness," Interfaces, vol. 8, no. 4, pp. 59-62, August 1978.

Goldfield, Randy J., "Achieving Greater White-Collar Productivity in the New Office," BYTE, pp. 154-172, May 1983.

Gosling, James J. and Lowell B. Jackson, "Getting the Most Out of Benefit-Cost Analysis: Application in the Wisconsin Department of Transportation," Government Finance Review, vol. 2, pp. 33-39, February 1986.

Grove, Andrew S., "Here's How the U.S. Can Increase Its Productivity," Unknown Newspaper, July, 29th 1980.

Haberman, Paul W., "The Use of A Psychological test for Recall of Past Situations," Journal of Clinic Psychology, no. 19, pp. 245-248, 1963.

Hall P. G. and T. J. Lincoln, "A Cost Effectiveness Study of Production and Engineering System within a tightly integrated Manufacturing Environment," Management Datamatics, vol. 5, no. 6, pp. 262-274, 1976.

Hambright, Thea Zelman, "Comparison of Information on Death Certificates and Matching 1960 Cencus Records: Age, Marital status, Race, Nativity, and Country of Origin," Demography, no. 6, pp. 413-423, 1969.

Hamilton, Scott and Norman L. Chervany, "Evaluating Information Effectiveness Part II: Comparing Evaluator Viewpoints," MIS Quarterly, vol. 5, no. 4, pp. 79-86, December 1981.

Hamilton, Scott and Blake Ives, "MIS Research Strategies," Information and Management, vol. 5, no. 8, pp. 339-347, December 1982.

Hamilton, Scott and Norman L. Chervany, "Evaluating Information Effectiveness Part I: Comparing Evaluation Approach," MIS Quarterly, vol. 5, no. 3, pp. 55-69, September 1981.

Hamilton, Scott, and Blake Ives, "The Journal Communication System for MIS Research," DATABASE, pp. 3-14, Winter 1983.

Hammer, Michael Dr., "Interview with editor: Senn, James A.," Society for Information Management, SPECTRUM, vol. 2, no. 6, December 1985.

Harris, Catherine L. et.al, "Office Automation: Making it Pay Off," Business Week, (Special Report), pp. 134-146, October 12, 1987.

Harvey, Jean, "Measuring Productivity in Professional Services," Public Productivity Review, no. 44, pp. 29-51, Winter 1987.

Hisrch, Paul M., "Organizational Effectiveness and the Institutional Environment," Administrative Science Quarterly, vol. 20, no. 3, pp. 327-344, September 1975.

Hogue, Jack T. and Hugh J. Watson, "An Examination of Decision-Makers' Utilization of Decision Support System Output," Information and Management, vol. 8, no. 4, pp. 205-212, August 1985.

Hyman, Herbert, "Inconsistencies as a Problem of Attitude Measurement," Journal of Social Issues, no. 5, pp. 40-41.

Ives, Blake, M. H. Olson and Jack J. Baroudi, "The Measurement of User Information Sarisfaction," Communication of the ACM, vol. 26, no. 10, pp. 785-793, October 1983.

Kapsales, Peter, "Before and After WP: An Office Automation Productivity Study," Journal of Systems Management, pp. 7-9, April 1986.

Katz, D., "Do Interviewers Bias Poll Results?" Public Opinion Quarterly, no. 6, pp. 248-268.

Keen, Peter G. W., "Value Analysis: Justifying Decision Support System," MIS Quarterly, vol. 5, no. 1, pp. 1-15, March 1981.

King, John L. and Edward L. Schrems, "Cost-Benefit Analysis in Information System Development and Operation," Computing Surveys, vol. 10, no. 1, pp. 19-34, March 1978.

King, William R. and Barry J. Epstein, "Assessing Information System Value: An Experimental Study," Decision Sciences, vol. 14, no. 1, pp. 34-45, January 1983.

King, William R. and Jaime I. Rodriguez, "Evaluating Management Information Systems," MIS Quarterly, pp. 43-51, September 1978.

Kriebel, Charles H. and Artur Raviv, "An Economics Approach to Modeling The Productivity of Computer System," Management Sciences, vol. 26, no. 3, pp. 297-311, March 1980.

Kriebel, Charles A. and Arthur Raviv, "Application of Productivity Model for Computer Systems," Decision Sciences, vol. 13, no. 2 pp. 266-284, April 1982.

Lago, Armando M. and Diego R. Roque, "Inventory Cost Saving Benefits from the Standardization of Computer Modular Instruments," Omega, vol. 15, no. 4, pp. 331-337, January 1987.

LaPlante, Alice, "CEOs Question Value of Investments in Information Systems," Info World, March 5, 1988.

Larcker, David F. and Parker V. Lessig, "Perceived Usefulness of Information: A Psychometric Examination," Decision Sciences, vol. 11, pp. 121-134, 1980.

Leeke, Jim, "Measuring Productivity: Do Managers Benefit from PCs?," PC Week, pp. 78-90, April 4, 1988.

Lewin, Arie Y. and John W. Minton, "Determining Organizational Effectiveness Another Look, and An Agenda for Research," Management Science, vol. 32, no. 5, pp. 514-538, May 1986.

Lincoln, T., "Do Computer Systems Really Pay-off?," Information and Management, vol. 11, no. 1, pp. 25-34, August 1986.

Lotus Dev. Co., "Take the Lotus HAL speedway to 1-2-3" (This shortcut can increase agency productivity 33%), Lotus advertisement on Federal Computer Week, pp. 9, July 25, 1988.

Lucas, Jr.,Henry C., Application and Implementation "Unsuccesfull Implementation: The Case of A Computer-Based Order Entry System," Decision Sciences, vol. 9, no. 1, pp. 68-79, January 1978.

Lucas, Jr. Henry C., "System Quality, User Reactions and The Use of Information Systems," Management Informatics, vol. 3, no. 4 pp. 207-212, 1974.

Lucas, Jr. Henry C., "The Use of Accounting Information System, Action and Organizational Performance," The Accounting Review, pp. 735-746, October 1975.

Lucas, Jr. Henry C., "Performance and The Use of an Information System," Management Sciences, vol. 21, no. 8, pp. 908-919, April 1975.

Mace, Scott, "Regis Merges Two Technologies (Hypermedia, Expert Systems More Effective Together Than Apart)," Info World, pp. 15-18, March 20, 1989.

Maggiolini, Piercarlo, "Office Automation Benefits:A Framework," Information and Management, vol. 10, no. 2, pp. 75-81, January 1986.

Maginnis, Ninamary B., "The Gains Of Automation Are Here, But Who Can Count Them?," COMPUTERWORLD, pp. 197, November 3, 1986.

Making Office Systems Pay Off, EDP Analyzer, vol. 23, no. 2, pp. 1-16, February 1985.

Mansour, Ali H. and Hugh J. Watson, "The Determinants of Computer Based Information System Performance," Academy of Management Journal, vol. 23, no. 3, pp. 521-533, September 1980.

Manzi, Jim, "Comdex Speech," COMDEX, Fall 1987.

Mark, Jerome A., "Measuring Productivity in Government (Federal, State, and Local)," Public Productivity Review, vol. 5, no. 1, pp. 21-44, March 1981.

Mason, Alan, and Daniel Ryan, et.al., "Computer and Productivity," Public Productivity Revew, vol. 8, no. 1, pp. 70-84, Spring 1984.

Mason, Richard O., "Measuring Information Output: A Communication Systems Approach," Information and Management, vol. 1, no. 5, pp. 219-234, October 1978.

Matlin, Gerald, "What Is The Value Of Investment In Information Systems?," MIS Quarterly, vol. 3, no. 3, pp. 5-34, September 1979.

McMillan, Charless J., "The Automation Triangle: New Paths to Productivity Performance," Business Quarterly, pp. 61-67, Fall 1987.

Melloan, Goerge, "Computers Elevate Product Quality Standards," The Wall Street Journal, pp. A21, October 11, 1988.

Miller, J. and B.A. Doyle, "Measuring the Effectiveness of Computer-Based Information System in the Financial Sector," MIS Quarterly, vol. 11, no. 1, pp. 107-124, March 1987.

Miller, Michael J., "Productivity Map Helps Managers to Set Goals, Measure Their Results," Info World, vol. 9, no. 29, pp. 43, July 20, 1987.

Money, Arthur, David Tromp and Trevor Wegner, "The Quantification of Decision Support Benefits Within the Context of Value Analysis," MIS Quarterly, pp. 223-236, June 1988.

Nagel, Ernest, "The Structure of Science," Harcourt Brace & World, NY 1961.

Neumann, Seev and Eli Segev, "A Case Study of User Evaluation of Information Characteristics for Systems Improvement," Information and Maagement, vol. 2, pp. 271-278, 1979.

Nover, Carol, "Airco's new approach to white collar productivity," Modern Office Procedure, pp. 186-191, October 1980.

Olson, Margrethe H. and Henry C. Lucas Jr., "The Impact of Office Automation on the Organizatio: Some Implications for Reserach and Practice," Communication of the ACM, vol. 25, no. 11, pp. 838-847, November 1982.

Parry, Hugh and Helen M. Crossley, "Validity of Responses to Survey Questions," Public Opinion Quarterly, no. 14, pp. 61-80.

Phillips, Derek L., and Kevin J. Clancy, "Response Biases in Field Studies of Mental Illness," American Sociological Review, no. 35, pp. 503-515.

Poppel, Harvey L., "Who Needs The Office Of The Future?," Harvard Business Review, vol. 54, no. 5, pp. 146-155, November-December 1982.

Pournelle, Jerry, "A User's View (Low Productivity, Inadequate Education Threaten U.S., Computer Industry)," Info World, pp. 57, October 19, 1987.

Raghunatan, TS and WR. King, "The Impact of Information Systems Planning on the Organization," Omega, vol. 16, no. 2, pp. 85-93, September 1987.

Reif, William E., Robert M. Monzka and John W. Newstrom, "Perception of the Formal and Informal Organizations: Objective Measurement Through the Semantic Differential Technique," Academy of Management Journal, vol. 16, no. 3, pp. 389-403, September 1983.

Richman, Tom, "Information Strategies: Paul Strassmann (American executives spend too much money on computer systems that allow them to do the wrong things faster)," INC, pp. 27-40, March 1988.

Robins, Lee N., "The Reluctant Respondent," Public Opinion Quarterly, no. 27, pp. 276-286.

Ruby, Daniel, "User Attitudes and management Information System Use," Academy of Management Journal, vol. 22, no. 3, pp. 527-538, September 1979.

Ruby, Daniel, "PCs in Business: Do They Pay For Themselves," PC Week, vol. 3, no. 44, pp. 73-80, November 4, 1986.

Ruby, Daniel and Richard L. Zeller, "Factors Affecting the Success and Failure of an Information System for Product Quality," Interfaces, vol. 8, no. 3, pp. 70-75, February 1978.

Rockart, John F., "The Changing Role of the Information Systems Executive: A Critical Success Factors Perspective," Sloan Management Review, vol. 24, no. 1, pp. 3-14, Fall 1982.

Rockart, John F., "An Approach to Productivity In Two Knowledge-Based Industries," Sloan Management Review, vol. 15, no. 1, pp. 23-48, Fall 1973.

Rowe, David L., "How Westinghouse measure white collar productivity," Management Review, pp. 42-48, November 1981.

Schiffer, Michael B. and James M. Skibo, "Theory and Experiment in The Study of Technological Change," Current Anthropology, vol. 28, no. 5, pp. 595-721, December 1987.

Schwartz Phd, Perry A., "Office Information Systems Cost Justification," CRA (Computer Research Associate Inc.), IEEE AES Magazine, pp. 21-26, August 1986.

Sechrest, Lee, "Testing, Measuring, and Assesing People," In Edgar F. Borgatta and William W. Lambert (eds.), Handbook of Personality Theory and Research, pp. 529-628, Chicago: Rand McNally 1968.

Singleton, John P., Ephraim R. McLean and Edward N. Altman, "Measuring Information Systems Performance: Experience With the Management By Result at Security Pacific Bank," MIS Quarterly, vol. 12, no. 2, pp. 325-337, June 1988.

Smith, Peter and David Mayston, "Measuring Efficiency in the Public Sector," Omega, vol. 15, no. 2, pp. 181-189, 1987.

Snitkin, Sidney R. and William R. King, "Determinants of the Effectiveness of Personal Decision Support Systems," Information and Management, vol. 10, no. 2, pp. 83-89, January 1986.

Srinivasan, Ananth, "Alternative Measures of System Effectiveness: Associations and Implications," MIS Quarterly, vol. 9, no. 3, pp. 243-253, September 1985.

Staats, Elmer B., "Measuring and Enhancing Federal Productivity," Sloan Management Review, vol. 15, no. 1, pp. 1-10, Fall 1973.

Steers, Richard M., "Problem in the Measurement of Organizational Effectiveness," Administrative Science Quarterly, vol. 20, no. 4, pp. 546-558, December 1975.

Stevens, S. S., "On The Theory of Scales of Measurement," Science, vol. 103, no. 2684, pp. 677-684, Friday, June 7, 1946.

Stix, Gary, "Justifying Costs: It Ain't Easy," DECISION Computer & Communications, pp. 74, September 1987.

Strassmann, Paul A., "The Real Cost of OA," Datamation, vol. 31, no. 3, pp. 82-94, February 1985.

Strassmann, Paul, "Information Payoff," COMPUTERWORLD, pp. ID/15-ID/32, February 11, 1985.

Strassmann, Paul A., "Managing the Cost of Information," Harvard Business Review, vol. 54, no. 5, pp. 133-142, January-February 1976.

Sullivan, Robert S. and Stephen C. Secrest, "A Simple Optimization DSS for Production Planning at Dairyman's Cooperative Creamery Association," Interfaces, vol. 15, no. 5, pp. 46-53, September-October 1985.

Summers, Gene F. and Andre D. Hammonds, "Toward a Paradigm for Respondent Bias Survey in Research," Sociological Quarterly, no. 10, pp. 113-121.

Swanson, Burton E., "Management Information Systems: Appreciation and Involvement," Management Sciences, vol. 21, no. 2, pp. 178-188, October 1974.

Tanner, Daniel J., "User Ratings of Software Packages," Datamation, pp. 138-141, December 1975.

Tarshis, Barry, "State of the Office (A Room with a view - BOSTI)," INC Office Guide, 1988.

Thor, Carl G., "White Collar Productivity Measurement," Productivity SA, pp. 3-11, July 1985.

Tittle, Charles R. and Richard J. Hill, "Attitude Measurement and Prediction of Behavior: An Evaluation of Conditions and Measurement Techniques," Sociometry, vol. 30, pp. 199-213, June 1967.

Udler, Allan S. and Kay Monte-White, "Measuring Common Administrative Services (Assessing Productivity of Operating Personnel Offices)," A Productivity Measurement Publication, April 1980.

Vitalari, Nicholas P., "The Need for Longitudinal Designs in the Study of Computing Environments," in Enid Mumford, et.al (editions), Research Methods in Information Systems, pp. 243-265, Amsterdam: North Holland, 1985.

Vogel, Douglas R. and James C. Wetherbe, "MIS Rerearch: A Profile of Leading Journals and Universties," DATABASE, pp. 3-14, Fall 1984.

Webb, Eugene J., and others, Unobtrusive Measures: Nonreactive Research in the Social Sciences, Rand McNally, Chicago, 1966.

Weiss, Carol, "Validity of Welafare Mothers' Interview Responses," Public Opinion Quarterly, no. 32, pp. 622-633, 1968.

Werthelmer, May, "Gestal Theory" in A Source Book of Gestalt Psychology, pp. 2, Willis Wllis, Edition, NY 1950.

Wessel, David, "Service Industries Find Computers Don't Always Raise Productivity," The Wall Street Journal, (Section 2), pp. 31, Tuesday, April 19, 1988.

Williams, J. A., Jr., "Interviewing respondent Interaction: A Study of Bias in the Information Interview," Sociometry, no. 27, pp. 338-352, 1964.

Worthley, John A., "Computer Technology and Productivity Improvement," Public Productivity Review, vol. 4, no. 1, pp. 10-20, March 1980.

Wyatt, D. F. and Donald T. Campbell, "A Study of Interviewer Bias as related to Interviewers' Expectations and Own Opinions," International Journal of Opinion and Attitude Research, no. 4, pp. 77-83, 1950.

Zarley, Craig, "The Crisis in Managing Corporate PC Assets," PC Week, April 26, 1988.

INITIAL DISTRIBUTION LIST

	No. Copies
1. Defense Technical Information Center Cameron Station Alexandria, Virginia 22304-6145	2
2. Library, Code 0142 Naval Postgraduate School Monterey, California 93943-5002	2
3. Department Chairman, Code 54 Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5000	1
4. Prof. William J. Haga, Code 54HG Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5000	1
5. Prof. Moshe Zviran, Code 54ZV Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943-5000	1
6. DIRDIKAU c/o MABES TNI - AU Jl. Jend. Gatot Subroto no. 72 Jakarta - Selatan, Indonesia	1
7. DIRPULLAHTA-AU c/o MABES TNI - AU Jl. Jend. Gatot Subroto no.72 Jakarta - Selatan, Indonesia	1
8. PUSPULLAHTA DEPHANKAM Jl. Merdeka Barat no. 13 Jakarta - Pusat, 12450, Indonesia	1

9. Lembaga Ilmu Pengetahuan Indonesia (LIPI) 1
Jl. Jend. Gatot Subroto no. 10
Jakarta - Selatan, Indonesia

10. Captain M. Agus Mustofa 1
BENGHAR 15, DEPOPESBANG 10
Lanud Husein Sastranegara
Bandung, Indonesia

11. Captain Aziz Akgul 1
Kara Harp Okulu
Ogretim Uyesi
Ankara, Turkey

Thesis
M9866 Mustofa
c.1 Validity of empirical studies of information system effectiveness.